October 1980
vol 6, no 10
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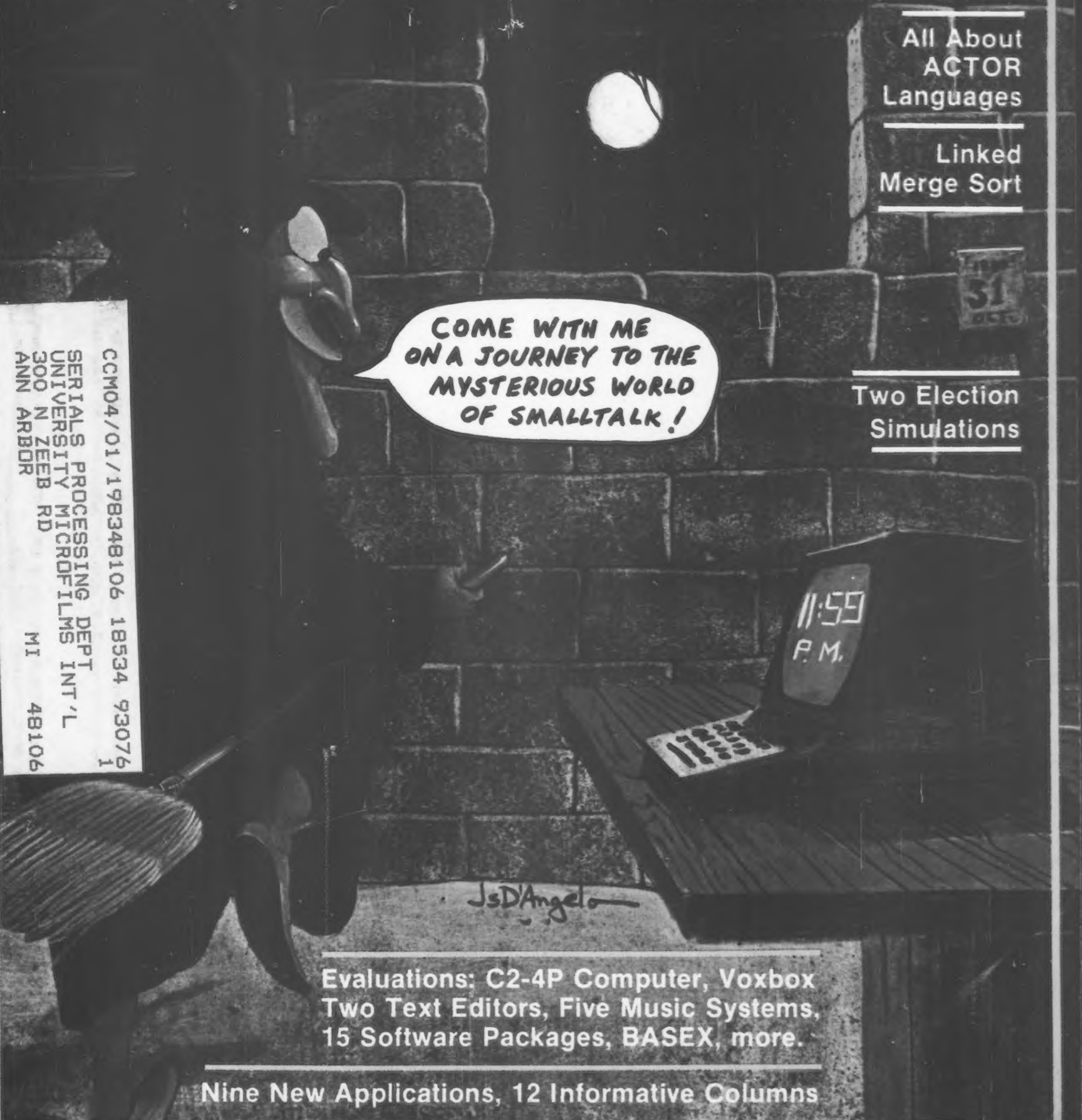
creative computing

the #1 magazine of computer applications and software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1
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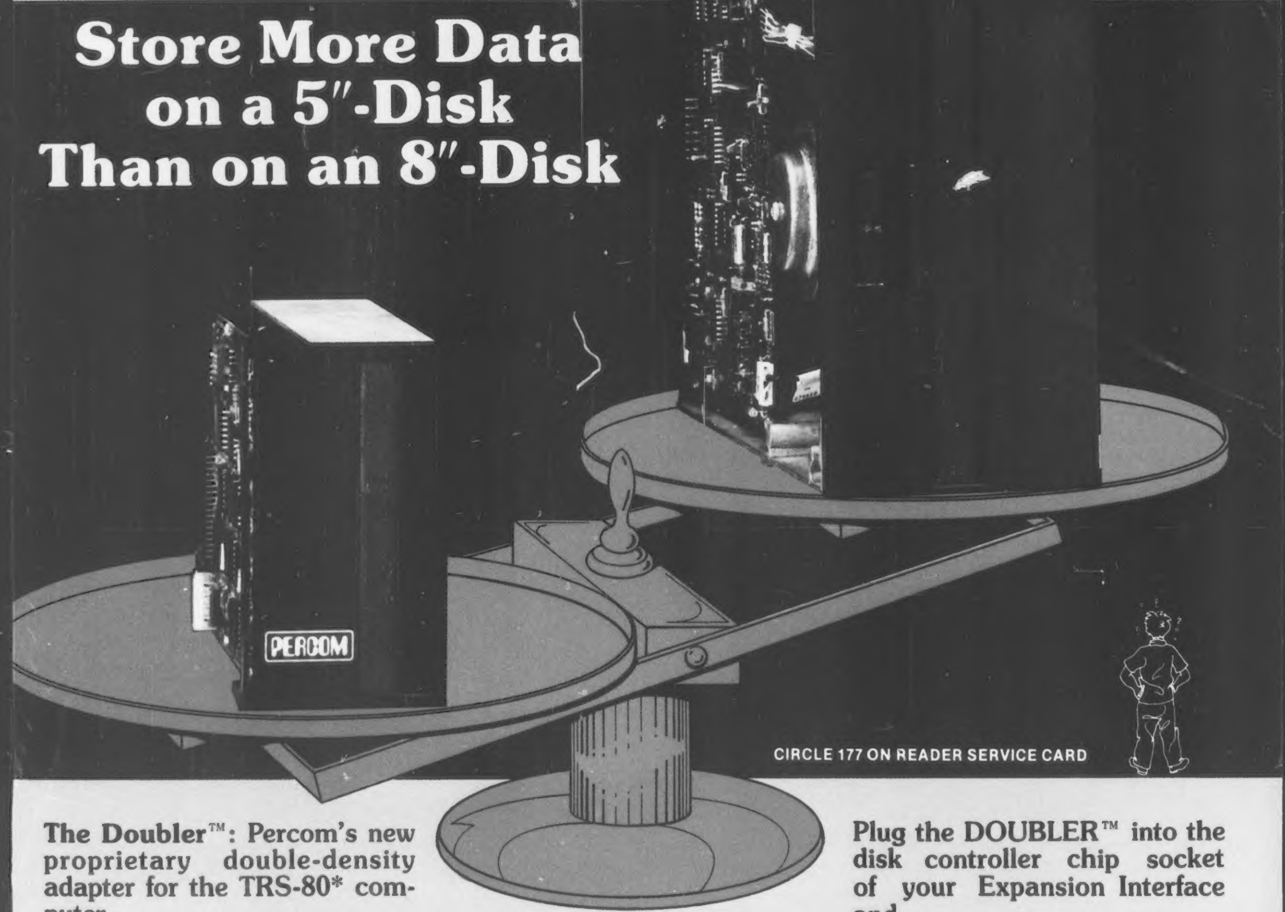

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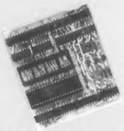

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1980

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1981

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Artificial intelligence. Interactions in the AI community.

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Educational applications. Winter CES coverage.

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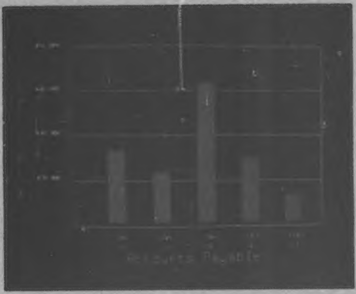
We have a comprehensive 6-page Author's Guide which tells our philosophy, provides writing guidelines and gives concrete examples of what we do and do not want. If you'd like a copy send a self addressed stamped #10 envelope (with 2 stamps) and we'll send you one. Send to Editorial Dept., Creative Computing, P.O. Box 789-M, Morristown, NJ 07960.

Subscribe to Creative Computing?

If you're not a subscriber, it's an especially good idea to subscribe now. We have not raised our subscription rate in 6 years since the magazine was founded (in fact we lowered it when we increased our frequency from bi-monthly to monthly). Inevitably, because of the rising cost of paper, printing, and postage we will have to raise the rate soon.



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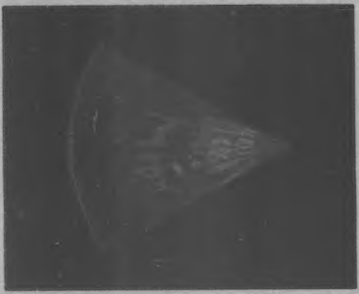

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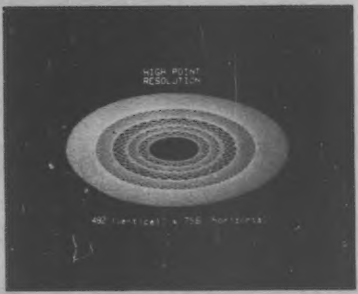

High-resolution display with alphanumerics

Get the professional color display that has BASIC/FORTRAN simplicity

LOW-PRICED, TOO

Here's a color display that has everything: professional-level resolution, enormous color range, easy software, NTSC conformance, and low price.

Basically, this new Cromemco Model SDI* is a two-board interface that plugs into any Cromemco computer.

The SDI then maps computer display memory content onto a convenient color monitor to give high-quality, high-resolution displays (756 H x 482 V pixels).

When we say the SDI results in a high-quality professional display, we mean **you can't get higher resolution than this system offers in an** NTSC-conforming display.

The resolution surpasses that of a color TV picture.

BASIC/FORTRAN programming

Besides its high resolution and low price, the new SDI lets you control with optional Cromemco software packages that use simple BASIC- and FORTRAN-like commands.

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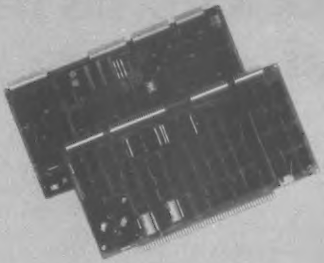

Model SDI High-Resolution Color Graphics Interface

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Model SDI plugs into Z-2H 11-megabyte hard disk computer or any Cromemco computer

DISPLAY MEMORY

Along with the SDI we also offer an optional fast and novel **two-port** memory that gives independent high-speed access to the computer memory. The two-port memory stores one full display, permitting fast computer operation even during display.

CONTACT YOUR REP NOW

The Model SDI has been used in scientific work, engineering, business, TV, color graphics, and other areas. It's a good example of how Cromemco keeps computers in the field up to date, since it turns any Cromemco computer into an up-to-date color display computer.

The SDI has still more features that you should be informed about. So contact your Cromemco representative now and see all that the SDI will do for you.

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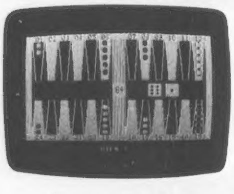
Gammon Gambler is a sure bet. With ten levels of skill, you can begin a novice and become an expert. Whichever level you play, the computer moves so quickly you don't have to wait. The program follows U.S. tournament rules, and includes the doubling cube to spice up the game. Written for the Apple and PET by Willy Chaplin.



Gammon Gambler

Checker King—you probably forgot how much fun it is! If you move and change your mind, take it back and move again—without a peep from the computer. Play eight skill levels. Add and remove pieces. Save three board positions for later play. And solve three challenging checker puzzles. Written by Michael Marks for the Apple, PET and TRS-80.

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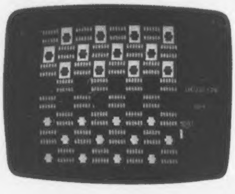
Time Trek is easy to learn, difficult to master and impossible to forget. Take command of a starship in real-time action to make the galaxy safe again. PET version by Brad Templeton. TRS-80 program by Joshua Lavinsky.



Checker King

Personal Software, Inc., also produces the VisiCalc™ program (the software that's revolutionizing personal computing), CCA Data Management System, the Vitafacts series and other exciting software for the Apple, PET and TRS-80.

Now that you've read about the Personal Software programs, go see a demonstration. For the name of your nearest Personal Software dealer, call (408) 745-7841 or write to Personal Software Inc., 1330 Bordeaux Dr., Sunnyvale, CA 94086.

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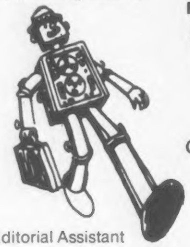

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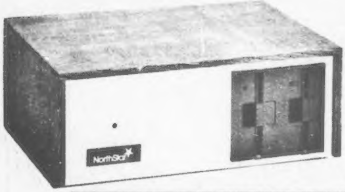

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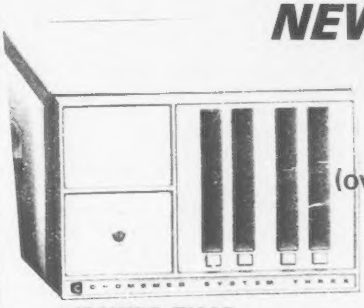

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TAEDS 1980 Annual Convention

The Texas Association for Educational Data Systems (TAEDS) 1980 Annual Convention will be held October 21-21st in Austin, TX. The theme will be: "New Tool for Education in the 1980's - computers".

The purpose of the convention will be to examine the use of computers in all levels of the educational process. Two phases will be examined: (1) Using the computer to teach computing and; (2) Using the computer as an educational tool in non-computing fields.

Hardware selection, maintenance problems, software selection, and the use of computers in existing computer facilities will be examined.

If you are interested in participating in or attending this convention, contact Dr. Phil Gensler, Department of CIS, West Texas State University, Canyon, TX 79016.

Reducing Data Loss

According to Lewis A. Whitaker, Executive Vice President of Innovative Computer Products of Tarzana, CA, a computer user can greatly reduce the incidence of data loss by following four simple guidelines.

First, keep magnetic media in covered containers. Disk Cartridges, cassettes, magnetic tape and floppy disks may look hardy, but they are extremely vulnerable to microscopic dirt particles.

Second, cover equipment when not in use. Use a plastic typewriter type cover to cover the disk drives, printer and C.R.T. It is better to keep contamination from a computer surface than to try and remove it once a problem has occurred.

Third, periodic media maintenance is important. Cleaning and testing of magnetic media will not only length the life of media, but will help maintain error-free processing over the life of the media.

Finally, there must be frequent drive maintenance. Dirt seems to gravitate to heads of magnetic media equipment. While hard disk drives do not have a head to media contact and, therefore, do not need to be cleaned as frequently, magnetic tape, cassette tape and diskettes all have head to media contact, and cleaning of these heads on a daily basis would surely minimize contamination caused problems.

According to Mr. Whitaker, if the above guidelines were followed by everyone, there would be fewer instances of unscheduled down time and fewer service calls to replace prematurely worn heads, not to mention the increased life of the media itself.

Northeast Computer Show

The Northeast Business and Home Computer Show will be held at Hynes Auditorium/ Prudential Center, Boston, Mass., November 20-23, 1980. Show hours are Thurs.-Saturday, 11 a.m. - 9 p.m., Sunday 11 a.m. - 6 p.m. Adult admission $5. An end-user public exposition featuring small and medium-sized business systems, scientific and engineering computers, micro-computers and electrotechnology, produced by National Computer Shows, P.O. Box 678, Brookline, MA 02147. Tel: (617) 524-4547.

Mid-West Computer Show

The Mid-West Computer Show will be held at McCormick Place, Chicago, IL, October 16-19, 1980. Show hours are: Thurs.-Sat. 11 a.m. to 9 p.m., Sunday 11 a.m. to 6 p.m. General adult admission $5. An end-user public exposition featuring small and medium-sized business systems, scientific, engineering computers and micro-computers. Produced by National Computer Shows, 824 Boylston Street, Chestnut Hill, MA 02167. Tel: (617) 739-2000.

MAUDE

Milwaukee Area Utility for Digital Exchanges (MAUDE) is a computerized bulletin board which is open to the public. Messages and notices can be posted and retrieved over the telephone using a standard computer terminal or terminal emulator. The system is oriented to the needs and interests of electronics and computer hobbyists. Typical message subjects include: "Need Help With . . . ", "For Sale", "Wanted", "Have Solution for Problem with . . . ".

A computer terminal equipped with a standard (Bell 103 compatible) modem is required to access MAUDE. Call MAUDE at (414) 241-8364. After about 4 rings, MAUDE will answer with a carrier tone. Connect the modem and type carriage returns until MAUDE responds with a greeting. MAUDE will then provide additional instructions for use. MAUDE supports 110, 300, 450 and 600 baud and operates with no ("marking") parity. When MAUDE is first accessed the system provides full duplex (i.e., incoming characters are echoed) and no nulls after carriage returns. Once logged on, users can change the baud, duplex mode, and number of nulls as needed.

MAUDE is available 24 hours/day, 7 days a week. If the system is in use, a busy signal will be received.

MAUDE exists as an experiment in electronic communications. Suggestions for improvements or modifications are welcomed, and will be implemented as appropriate.

MAUDE is a service of a group of Milwaukee area computer hobbyists.

Additional information may be obtained by contacting John Taylor, Box 121, Hartland, WI 53029.

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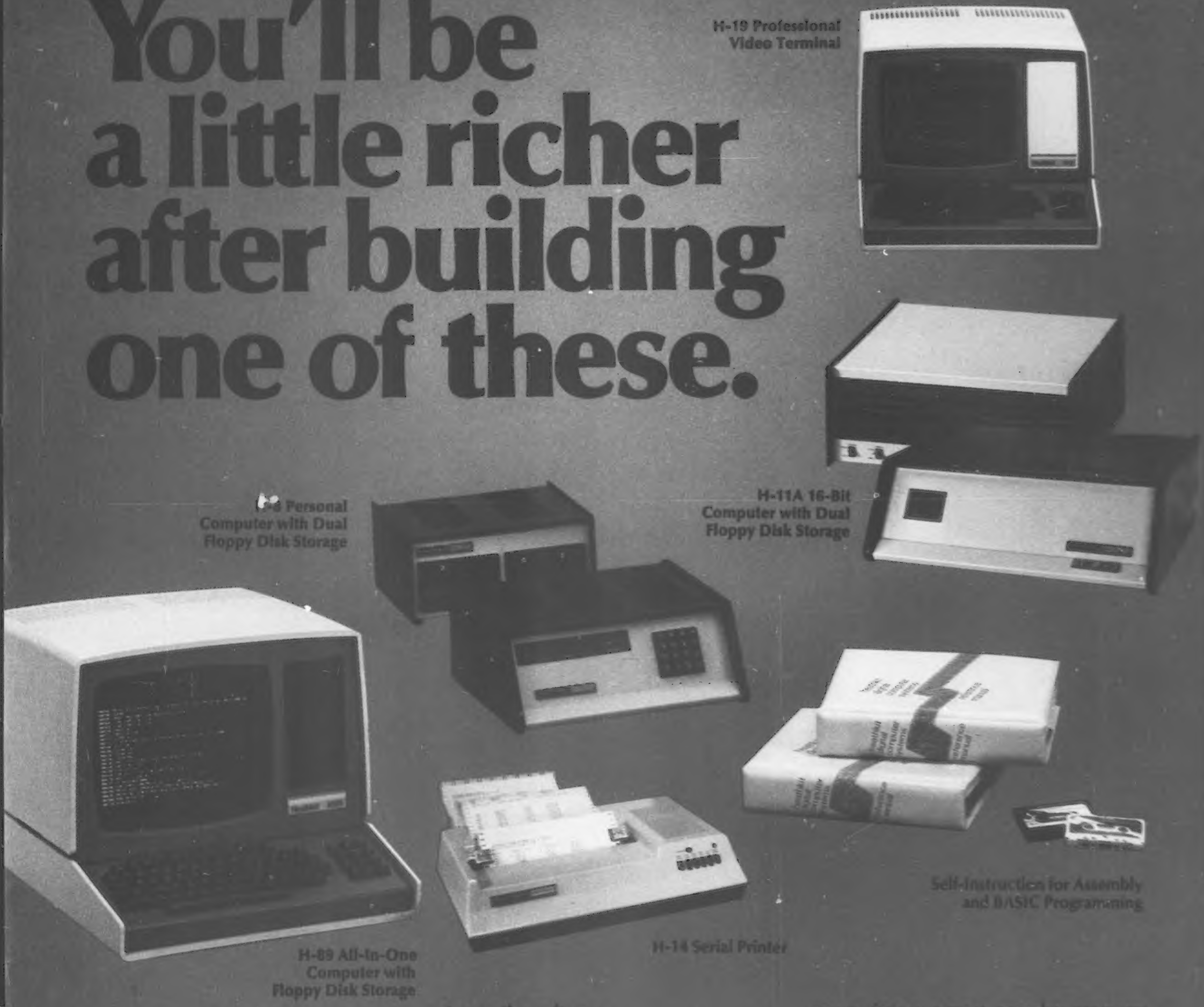
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CP-186

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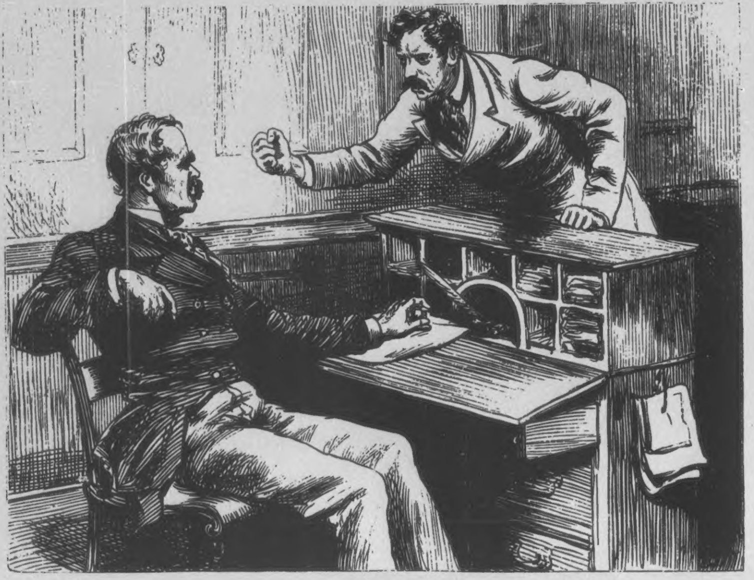
Input/Output



On Hold

Dear Editor:

Your article "The Atari Machine" which appeared in the June '80 issue of *Creative Computing* caused me many sleepless nights wondering how the Atari graphics work. Lucky for me, I think that I have the answer now. One evening while having a slice of pizza in one of the local fast food shops I was overcome by a breathtaking display of dozens of "spaceships" moving smoothly in every direction on the screen of an electronic game nearby. I had an immediate inspiration! Did you ever (of course you did) move the vertical hold control of a TV set and note the way that you can cause the picture to move up and down at any speed that you wish? There was the answer!!

Refer to the upper portion of Figure 1.

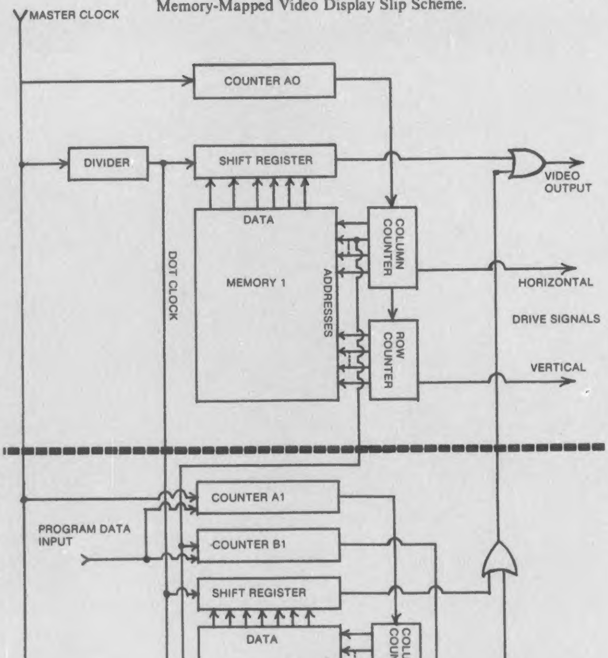
The upper half of this figure represents, in highly simplified form, a typical memory-mapped display system. For clarity, microprocessor I/O buss structure, gating, etc. has been omitted. In fact, one may consider the memories to be ROM for purposes of reproducing fixed patterns on the display. Synchronism of the displayed information stored in Memory 1 is a natural outcome of the fact that memory addressing is obtained from the same counter chain that supplies the display raster vertical and horizontal drive signals.

Now, note the lower portion of Figure 1. A second memory, shift register and set of column and row counters have been added to the system. Note that Counter A1 and an additional counter Counter B1 are each of the programmable type. Setting Counter A1 to a division ratio different from that of the fixed counter A0 in the base system will cause a change of the frequency supplied to the column counter. The result will be to cause the image pattern stored in Memory 2 to "slip" horizontally over the fixed Memory 1 pattern at a rate of speed and direction (left or right) determined by the programming constant. The alteration of Counter B1's division ratio will likewise cause the Memory 2 pattern or object to slide over the base system pattern except in the vertical axis instead. Combinations of horizontal and vertical motion will of course enable object motion along any vector desired. Additional objects, each capable of motion independent from the others are easily incorporated by duplicating the hardware shown in the lower part of Figure 1.

Did I hit upon the method used in the Atari machine? If not, this might be just another way of doing the same thing. When I get a chance, I'm going to breadboard this scheme onto my one-and-only microprocessor system, a 6502 breadboard with 2K RAM and a TIM monitor that I built in early '77 and still works fine.

Armand Lucchesi
74 Booraem Avenue
Jersey City, NJ 07307

Figure 1.
Memory-Mapped Video Display Slip Scheme.


MASTER CLOCK
COUNTER AO
DIVIDER
SHIFT REGISTER
DATA
MEMORY 1
ADDRESSES
DOT CLOCK
COLUMN COUNTER
ROW COUNTER
VIDEO OUTPUT
HORIZONTAL
DRIVE SIGNALS
VERTICAL
COUNTER A1
PROGRAM DATA INPUT
COUNTER B1
SHIFT REGISTER
DATA
MEMORY 2
ADDRESSES
COLUMN COUNTER
ROW COUNTER
TIMING SIGNALS TO ADDITIONAL OBJECT SYSTEMS
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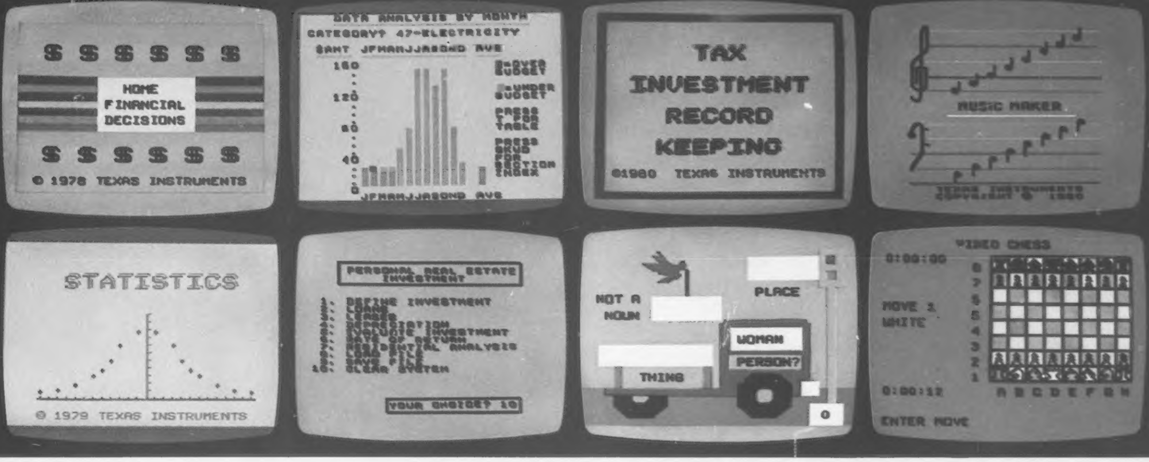
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$ $ $ $ $ $
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YOUR CHOICE? 10
NOT A NOUN
PLACE
WOMAN
PERSON?
THING
VIDEO CHESS
MOVE 1 WHITE
ENTER MOVE

Texas Instruments is looking for unique home computer programs. If you have some, we can help you turn them into profit makers. To begin with--you could win up to $3,000. You'll still own the programs...we may help you sell them.

One of the most exciting things about the home computer revolution is discovering the many ways a computer can be used.

If you've been working with small computers for a while, chances are you've developed some innovative application programs. This is your chance to put them to work — for a profit.

Texas Instruments is looking for quality programs. We've created an Author Incentive Program to make it worth your while. The award for the top program will be $3,000. And there are five $1,000 awards, plus twenty $500 awards. All winners will be recognized with national publicity. Even if you don't receive one of these monetary awards, we may see enough market potential for your program to help you develop it and sell it.

We want programs that offer real utility and lasting value. Programs that are self-teaching, that communicate on human terms. After all, the TI Home Computer was designed to be the first home computer the whole family can use.

TI is interested in education, personal finance and technical or managerial programs for professionals. Home management programs, hobby and simulation programs. We prefer that your submissions exclude entertainment packages.

Your entry can be a program you've created for use on the TI-99/4 or other microcomputers — in any high-level language, from Pascal and BASIC to FORTRAN or COBOL — or even assembly language. All the way up to 48K RAM.

Keep in mind that programs for the TI Home Computer can incorporate high-quality color graphics, music and sound effects, and TI's remarkably-human synthesized speech.

To submit an entry, call the toll-free number below or use the reader service card in this magazine. We'll send you an entry submission form plus full details. *Please don't send anything until you receive and fill out this entry form.*

Programs must be in by November 15, 1980 — so get your entry form soon.

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For an entry form, call 1-800-858-4565.

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I/O cont'd. . .

Educators and the Computer

Dear Editor:

In your interesting article on the Atari there was a backhanded slap at "pompous educators" which struck a nerve. I don't know who "they" were, but they must have something on the ball to invite Lud Braun.

Another aside you made hurt more than my ego, however. The reaction you reported to Lud's demo of a fancy graphics shoot-em-up game was predictable. Your parenthetical reaction to their ignorance was more serious than your slander of them because it reminded me of the real barrier that stands between technically naive educators, and computer people, and which inhibits the computer from being used appropriately, efficiently, and sufficiently in education.

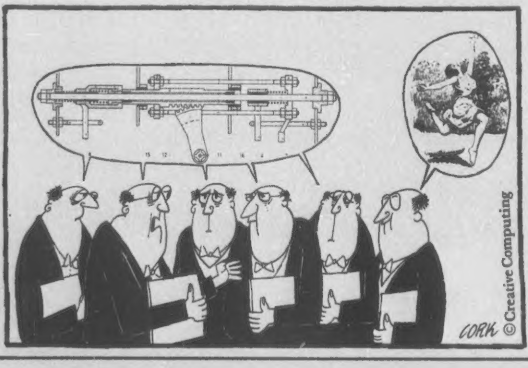
I agree with you that the program shows how great the Atari is and how useful it could potentially be in a wide range of educational applications. But it is not *their fault* that they cannot see the way to get from spectacular graphics to an instructional setting. Educators don't tend to have good programming or technical backgrounds and need the help, not the scorn, of those who do have such skills. They (we!) may not have enough imagination and creativity to make the best use of the machine, but again, it is not our fault. We need help, and we are at fault if we are given the information and choose to ignore it irrationally. (You don't say what else Lud said about the Atari, but I sure hope his presentation helped the people see the possible applications and how to begin to achieve them.)

The surest way I have seen to turn off money for computers in schools is for the administrators to get the impression that it's all fun and games. Writing versions of Pong and Star Trek, or modifying the originals, is a great programming experience for sharp kids. Also, games are a good way to introduce the computer to neophytes and to attract the disinterested. But we have to show that we are offering more than can be found at the local pizza parlor and that we can use the computer to help educate the full range of kids in schools.

It is my observation that right now teachers and administrators are generally looking favorably at computers. For this interest to be translated into real curriculum and more productive (and more human!) schools, we desperately need the cooperation, not the condescension of those who can produce the programs we need.

William J. Wagner, Ph.D.
Mathematics and Computer Science Teacher
Mountain View High School
Mountain View, CA 94041

Agreed. Educators need all the help they can get. But how do we open their eyes to the power and excitement of the graphics and the games? And what is a "game," anyway, but a simulation (at some level) that's enjoyed? And are you saying that if it's in a pizza parlor it can't educate? — *Ed.*



Flash! Apple Degibbered

Dear Editor:

My dealer has recently solved a problem with my Apple II Plus which had been driving me crazy. Hopefully, someone else can now benefit from the solution.

The problem was that occasionally when editing a line, as the cursor would pass over certain characters, it would produce gibberish and subsequently the edited line would be rejected (syntax error). What my dealer finally discovered was that the problem only occurred when the machine had been in the "flash" mode and then the reset key was pressed to edit. The solution of course is simple (aren't they all?); type in "normal" before editing.

Gary Markman
138 Colonial Pky.
Yonkers, NY 10710

* * *

Effective Writing

Dear Editor:

I enjoy and profit from the series, "Effective Writing."

What was your motive to include it in a magazine devoted to computer applications? Could it have been the Eighth Law of Computer Programming?

"When the art of programming reaches the stage where programs can be written in English, it will be discovered that programmers cannot write in English."

Ian A. Morton
1500 Goodrich Avenue
St. Paul, MN 55105

The "Eighth Law" was not the reason I started the column, but it seems applicable. Sad to relate, we have already discovered that many people who submit material for possible publication do not have a good command of English. As a result, many good ideas are so muddy and garbled that they never get into print. — *DHA*

* * *

Self-Reproducing Programs

Dear Editor:

The "Self-Reproducing Programs" in the July *Creative Computing* were interesting. But why were they so complex? Unless I've missed the point of it, the enclosed listing represents the simplest method of reproduction.

```
        ROCKWELL AIM 65

     LIST
      10 REM TEST 7/1/80
      20 LIST

     RUN
      10 REM TEST 7/1/80
      20 LIST
```

Steve Bresson
1302 Strawberry Lane
Hanover, MD 21076

We appreciate the elegance and symmetry of your solution. The issue is not merely that the program should print itself out, but that it should do so listlessly. — *Ed.*

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Jerry Pournelle
On Computing, Summer 1980

“The basic functions of the Magic Wand editor are as easy to learn as those of Electric Pencil*. . . . Magic Wand dominates in the area of print formatting.”

Larry Press
On Computing, Summer 1980

“Of all the word processors I have used (and that includes a dozen or more), the Magic Wand is the most versatile. The Wand has almost all of the features of other processors, plus many new ones of its own. It measures up to even the word-processing software running on the largest mainframe computers.”

Rod Hallen
Microcomputing, June 1980

“The Magic Wand is one of the most flexible word processing packages available, and should be considered by any potential word processing purchaser.”

Glenn A. Hart
Creative Computing, August 1980

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WordStar is a trademark of Micro Pro International, Inc.
CP/M is a registered trademark of Digital Research Corp.

ium...compendium...co

Computer Can't Keep Its Mouth Shut

Forget Mr. Ed and Frances the Talking Mule and all the other talking animals.

This is the age of the talking computer. You knew it was bound to happen as a logical sequence in today's highly technical society.

Ted Menten, a 69-year-old Melbourne, Florida resident, welcomed that age when he ordered a Votrax module to his Digital Group Computer. It now "lives" in the room of his home that also houses what he calls Cape Kennedy South — walls literally filled from floor to ceiling with highly sensitive and technical ham communications equipment.

Menten said he has been a ham for 57 years. But the gregarious, smiling man is nothing compared to his circuited friend.

"I am the Ted Menten Talking Computer," it says by way of introduction. "Please, not tonight. I have a headache."

The computer's "voice" is tinny, monotonous and without inflection — although Menten says he can pick up traces of dialect and has taught it to say things like "Ya'll come up and see me sometime."

Actually the Votrax's voice is not a voice at all. It's a combination of some of the two billion phonetic sounds — phonemes — programmed into the computer. Those sounds can presently be translated in English, Spanish or Latin. Once Menten gets the proper programs, his multilingual buddy will also be able to converse in Russian and Yiddish.

"It only knows numbers and all the things on the keyboard are translated into numbers," he said.

Menten has so far taught the computer to pronounce about 900 words and to speak eight sentences.

"I've got 10,000 hours as a private pilot and I've done all the scuba diving you'd care to. I was a member of the Saddleites and I did acrobatics on motorcycles. But I work on this eight hours a day, seven days a week. It's just so much fun getting these words to come out."

Although the computer only has "speaking" capabilities at present, Menten said the day of the computer actually answering a question isn't too far off.

While he isn't worried that his Votrax will follow the berserk ways of HAL — the neurotic, power-hungry computer in the movie "2001" — Menten said the Votrax manages to keep him in his place.

When he makes a mistake in programming, the Votrax tells him, "You goofed, dummy."

"This keeps me young," he said.

Computer Fairy Tale

Once upon a time George Ant lived near a patch of ground. There was a nest in an ash tree. Wilma Bird lived in the nest. There was some water in the river.

Wilma knew that the water was in the river. One day Wilma was very thirsty. Wilma wanted to get near some water. Wilma flew from her nest across a meadow through a valley to the river. Wilma drank the water. Wilma wasn't thirsty anymore.

George was very thirsty. George wanted to get near some water. George walked from his patch of ground across the meadow through the valley to a river. George fell into the water.

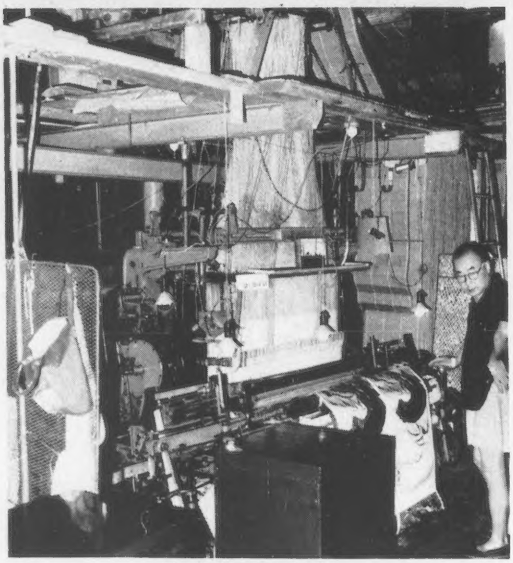
George wanted to get near the valley. George couldn't get near the valley. George wanted to get near the meadow. George couldn't get near the meadow. Wilma wanted George to get near the meadow. Wilma wanted to get near George. Wilma grabbed George with her claw.

Wilma took George from the river through the valley to the meadow. George was devoted to Wilma. George owed everything to Wilma. Wilma let go of George. George fell to the meadow. The end.

This story is a sample output from Tale-Spin, a new computer program developed by specialists at the University of California's Irvine campus. Tale-Spin is able to write stories by using knowledge about problem solving, relationships between characters, bodily needs, character traits and story structure. The computer is given a goal or moral on which the story is to be based and then produces the story.

— Boston Globe

Jacquard Loom in Hangchow, China



The Mathematical Intelligence

Jacquard looms are still widely used in China in the silk brocade apparel industry. The loom, perfected by J. M. Jacquard in the beginning of the 19th century, was the first practical automated industrial machine. It was controlled by punched cards long before the use of such cards to encode data for computers.

Pictured is a loom in a Hangchow silk mill. Designs there range from simple two-color panels to large elaborate 24-color brocades with the design encoded in 90,000 cards.

Cards are "keypunched" with the encoded design patterns. The cards, approximately three times the size of a modern punch card, are then sewn together into large decks.

A Short Episode

I know a fellow, a long-time programmer, who swears the following episode took place between himself and a user.

The user, an accountant or equally uncreative type, wanted a computer listing which would be a series of columns and rows of numbers, with the row and column totals printed beside and below them respectively. My friend, the programmer, decided that the user didn't need to know the row totals for some reason. He's pretty sharp, and probably was correct. So he told the user that it was impossible to print out the row totals on each line.

The user questioned this statement, but not with much conviction. So the programmer replied, "Just think about it. Would you be able to add these numbers sideways?"

The user admitted he would have trouble doing it.

"Well, there you have it," my friend said. "The computer can't do it either." Case closed.

Susan J. Wilkins

The Ultimate Cadillac

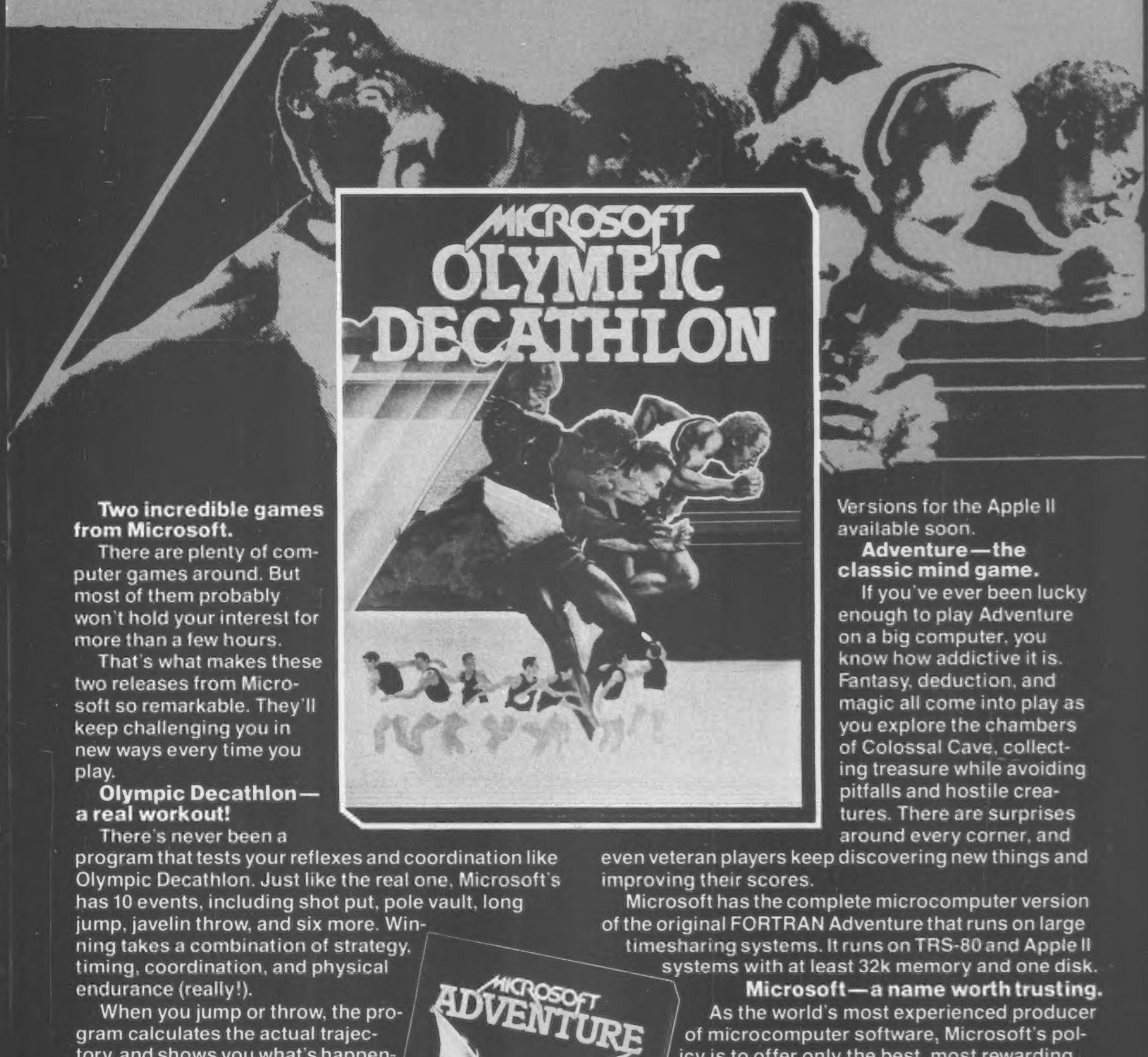
The Berliner Computer Center, a division of Berliner Electronics, Inc., with stores in Nassau and Queens, NY, has completed the installation of a complete data processing center in a 1980 Custom Cadillac limousine.

The vehicle's owner, Mr. William Kelly, founder and president of SAI Electronics of Farmingdale, Long Island, felt a need for the ability to process data during normally unproductive commutation time.

The computer is a 6502 microprocessor based system with 48K of RAM, 232K of disk storage and three languages resident in ROM. There is also sixteen color capability and complete sound synthesis, among numerous other luxury items.

A custom software package was written by Mr. Al Di Blasi of Berliner Computer Center which includes several data base management systems and a variety of entertainment programs.

After you've broken the pole vault record, see if you can outsmart the killer dwarves.



Two incredible games from Microsoft.

There are plenty of computer games around. But most of them probably won't hold your interest for more than a few hours.

That's what makes these two releases from Microsoft so remarkable. They'll keep challenging you in new ways every time you play.

Olympic Decathlon— a real workout!

There's never been a program that tests your reflexes and coordination like Olympic Decathlon. Just like the real one, Microsoft's has 10 events, including shot put, pole vault, long jump, javelin throw, and six more. Winning takes a combination of strategy, timing, coordination, and physical endurance (really!).

MICROSOFT
ADVENTURE

When you jump or throw, the program calculates the actual trajectory, and shows you what's happening with exciting animated graphics. After each event, the scores of all competitors (up to 8) are displayed. It's the ultimate party game to show off your computer!

Disk-based Decathlon runs on a 32k TRS-80. The cassette version requires a 16k Level I or Level II system.

Versions for the Apple II available soon.

Adventure—the classic mind game.

If you've ever been lucky enough to play Adventure on a big computer, you know how addictive it is. Fantasy, deduction, and magic all come into play as you explore the chambers of Colossal Cave, collecting treasure while avoiding pitfalls and hostile creatures. There are surprises around every corner, and even veteran players keep discovering new things and improving their scores.

Microsoft has the complete microcomputer version of the original FORTRAN Adventure that runs on large timesharing systems. It runs on TRS-80 and Apple II systems with at least 32k memory and one disk.

Microsoft—a name worth trusting.

As the world's most experienced producer of microcomputer software, Microsoft's policy is to offer only the best, most rewarding programs in existence.

After playing Adventure and Olympic Decathlon, we think you'll agree.

Visit your computer retailer soon for a real challenge. Or ten.

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ium...compendium...co

Programming — the hard way

How does he do it? First he needs the help of Noah, his seeing-eye dog to get to work. Once there Wayne relies heavily on tape recorders and braille and he has had to master the typewriter as well. He also uses a fancy gadget called an Optacon, which features a small camera that scans printed material. Wayne inserts his finger in a groove in the machine to "read" what the camera picks up. He also uses his Optacon for personal reading, going through a 280-page paper back book in six weeks.

Employees in Management Information Systems work in a world apart. They're hidden away in the Municipal Building sub-basement where they do magic things with the computer and talk to each other in a language the rest of us can't begin to understand.

A computer programmer needs specialized training to perform his exciting job. Good eyesight is also a must. Wayne Smith is a computer programmer. He's been to school and his programs are accurate. But Wayne Smith is blind.

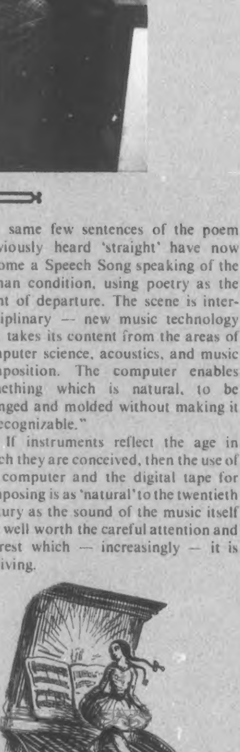
The Computer and Music

As students wait for printouts of their work on the computer, one senses their deep involvement. They are trail blazers, dealing each day with the many problems of computer composing in order to extend possibilities, to hear the music that is inside their heads, and, after much work at transforming it, to share it.

Professor Charles Dodge, Director, says, "Speech is extended here in musical and dramatic ways." He has been "playing the computer for the last fifteen years," and was attracted to electronic music because it fit his special kind of creative need and was a way to hear the music he was thinking about. "It had much more to offer me than writing standard works."

For a novice, the trick is to listen carefully to the music without expectation to tone, pace and texture, and not struggle with the intricacies of the technology. Listen first while Charles Dodge plays part of a short poem, a few sentences from a tape about time and a man's feelings. A moment later the electronic version of this voice describes a sound that is a voice, yet not quite a voice, alternately high and low, slow, then stacatto, with a surprisingly wide range, going back on itself, remarkably rich and complex, evoking feeling and producing laughter from the listener. The same few sentences of the poem previously heard 'straight' have now become a Speech Song speaking of the human condition, using poetry as the point of departure. The scene is interdisciplinary — new music technology that takes its content from the areas of computer science, acoustics, and music composition. The computer enables something which is natural, to be changed and molded without making it unrecognizable."

If instruments reflect the age in which they are conceived, then the use of the computer and the digital tape for composing is as 'natural' to the twentieth century as the sound of the music itself and well worth the careful attention and interest which — increasingly — it is receiving.



Computer Speeds Patient Treatment, Care

Touro Infirmary in New Orleans is using a computer system to help provide faster treatment for patients.

An IBM computer system links the hospital's Ambulatory Treatment Center (ATC), recovery room and intensive care unit to the lab and radiology department so test and x-ray results can be transmitted quickly to waiting doctors and nurses. This fast transmission of results means over 140 ambulatory and emergency patients can be cared for and treated daily without needless delay.

The ATC, recovery room and intensive care unit are linked to the lab and radiology department by terminals tied into the hospital's IBM System/370 Model 138 computer eliminating the need for doctors or nurses to call by phone to find information they need or transcribe by hand what the lab or radiology department may phone to them. This results in significant savings in time and money. More important, speedy transmission of diagnostic results can save lives in critical cases.

"Not having to transcribe anything by hand is more than just a time-saver — it also eliminates the possibility of someone making an error as he or she writes down the information," Dr. Jeanne Devron says.

The computer network also eliminates the need for any of the nursing staff to "bird dog" progress on tests. Once they are done, the results are sent out over the computer immediately.

Cheat-Proof Microprocessor Based Slot Machines In Vegas

The Nevada Gaming Commission has approved a new microprocessor based conversion package for slot machines.

A microprocessor controlled slot machine and a conversion package were submitted for evaluation to the technical staff of the Nevada Gaming Board by Summit Systems, Inc. On site units were installed for a 60 day trial period at the Cal-Neva Hotel and Casino in Reno and at the Four Queens Hotel and Casino in Las Vegas where they passed the performance criteria as set by the Nevada Gaming Commission.

These machines (controlled and converted) are believed to require less maintenance and to be more "cheat-proof" than electro-mechanical slot machines. In addition, microprocessor controlled machines and converted machines would be compatible with a cost accounting and security system developed by Summit.

Slot machines outfitted with the microprocessor conversion package retain the same elements of chance and "player appeal" as existing slot machines.

Summit has filed a registration statement with the Securities and Exchange Commission relating to the offer and sale of approximately 2.5 million shares of its Common Stock to the public by means of an underwritten offer and to stock, note and debenture holders of Interscience Systems, parent company of Summit, by means of a rights offer to these holders.

Popular Science In The Library

A pilot project at the University of California, Irvine will bring computers into public libraries to help adults learn more about science.

The computers will teach mini courses on topics such as accurate measurement and concepts about the sun.

Dr. Alfred Bork, director of the project, professor of physics and information and computer science, is a pioneer in the use of computers for learning. He is developing the computer learning modules with a two-year grant of nearly $200,000 from the Federal Fund for the Improvement of Post-secondary Education. The computers will be installed in two or three Orange County, California public libraries and the material will spread into other public locales — such as shopping centers and science museums — if the response is positive in the Orange County libraries. "Our aim is for the users of these learning modules to learn more about scientific theories, including how the theories are created, how they are evaluated and how they are connected to everyday experiences," Dr. Bork says.

The 10 to 15 minute learning modules, dialogues between the user and the computer, are designed for persons with little or no scientific training. Each module will contain a certain degree of flexibility for use by many people with very different backgrounds.

As the user "converses" with the computer, by typing responses to questions, the extent of the user's knowledge will be determined. For example, the computer might determine if the user has a knowledge of negative numbers. If so, the program will proceed in one direction. If not, a less advanced lesson will be taught.

One topic already under preparation deals with measurements. A small ruler adjacent to the computer will be used during the lesson. The initial "conversation" with the computer is simple and becomes more complex as the lesson progresses. At the outset users are asked to state their height and then to measure their own little fingers. Concrete examples of the need to obtain accurate measurements in the home environment are used. For example, measuring a window for a shade, a room for carpeting and a piece of cloth for a skirt.

Later several measurements are taken where the results do not tally, where obstacles prevent direct measurements and where the object being measured is longer than the measuring device.

The computers will initially run in an "attract" mode in which the screen flashes pictures and words designed to stimulate interest and attract potential users. Once the user sits at the computer, the program greets the person and the lesson begins.

Scientific authorities and experts on learning working with Dr. Bork on the development of the learning modules include faculty members from UCI, UC Berkeley, the Lawrence Berkeley Laboratory, UC Davis, Cal State Fullerton, State University of New York at Stony Brook and the University of Washington and the director of the Orange County Experience Center.

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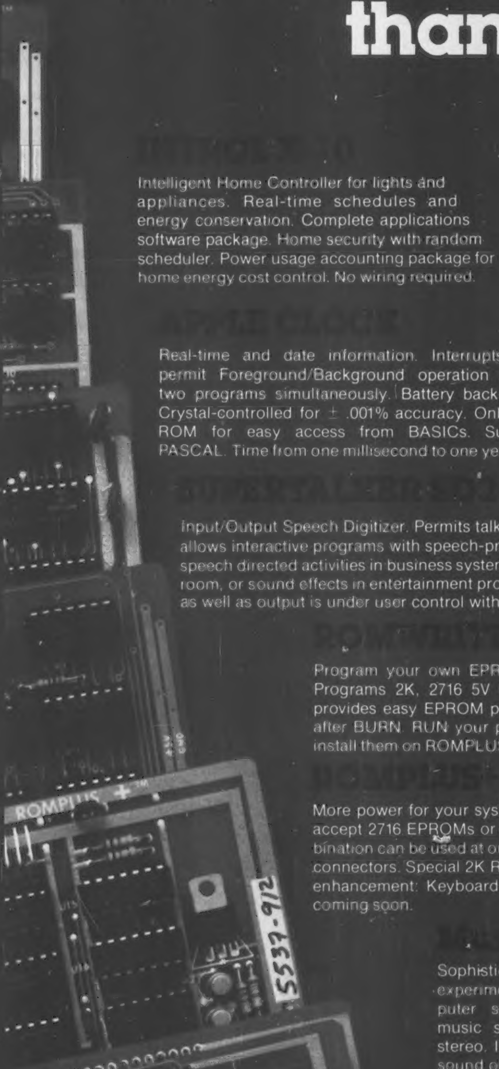

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The C2-4P Ohio Scientific Computer

Jim McClure

There has been a great influx of new computer models into the personal computer market in recent months. Some of these machines incorporate innovative features while others are merely copies of previous models. In this review I will be examining a computer from Ohio Scientific, the C2-4P, which I feel has some new and useful features which make it unique.

The C2-4P is a portable small computer intended for personal use. It consists of two cabinets; one houses the keyboard, 6502 central processing unit, 24K read/write memory, video graphics board and assorted interface circuitry. The other contains a minifloppy disk drive and its associated electronics. Photo one depicts the basic system.

Sometimes I honestly wonder whether the world's game programmers aren't a mass of frustrated anaesthesiologists. Of course, even the worst and most pitifully boring computer game is better than television.

The C2-4P is a personal computer and its price reflects this fact. The basic system sells for $1695, not including the video display (OSI recommends a Trinitron or comparably good TV.) In addition to the above hardware, the C2-4P also comes with several diskettes of ready-to-run software including Basic and a disk operating system. These features provide the user with all the basic computing necessities so that the system can be used from the moment it is delivered.

The C2-4P is unique in that it comes equipped with many features specifically designed for use in the home. Lately, there has been much emphasis on personal computers as controllers — i.e., their use to control appliances, thermostats, and other household items. If you are interested in applications such as these the C2-4P may be an ideal machine for the job. Unlike most other small computers, the C2-4P comes standard with many special purpose devices including a digital-to-analog converter, a programmable tone generator, a real-time clock/interrupt system, a count-down timer, and a set of parallel input/output lines for connection to switches, appliance controllers, and other external circuits. These features, combined with appropriate external hardware, allow the C2-4P to perform many household tasks.

For example, the digital-to-analog converter (or DAC for short) acts as an interface between the computer and the outside world. It takes binary words from the computer and converts them into voltages. The output from the DAC can be used to provide continuously varying control over external circuits. Suppose that an indoor gardener wished to control the amount of light his plants received according to the time of day, in order to simulate an outside environment. The output from the DAC could be connected to a circuit much like a light dimmer. The computer's real-time clock would then be used to keep track of the time of day, and a program could be written to output different values to the DAC according to the clock.

To give another example, the C2-4P would make an excellent energy watchdog. The computer could be programmed to act as a sophisticated thermostat, feeding variable amounts of fuel to the heating system depending on the temperature in the rooms and the time of day. Several thermosensors could be placed in various rooms of the house and connected to the C2-4P via the parallel input lines. The computer would then monitor these lines and switch on the furnace (via the output lines and perhaps a relay) when the temperature in any one of the rooms dropped below the desired level. This would not be such a difficult project in many cases, since gas or oil-burning furnaces are generally controlled by electronic solenoids anyway. Furthermore, the computer could keep a permanent record of fuel use, which could be used to predict future energy costs and to detect periods of peak energy use.

Admittedly, these are complex projects, and could be undertaken only by

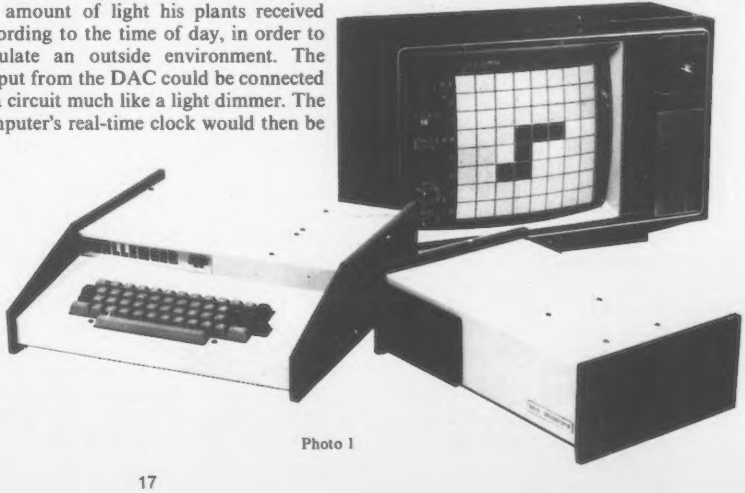

Photo 1

Jim McClure, 1019 Van Kirk St., Philadelphia, PA 19149.

someone with a fair background in electronics. However, for those interested in projects like these, the C2-4P comes with much more standard interface hardware than most other computers in the same price range. Photo two shows the C2-4P along with optional external sensors and controllers.

There is one particularly simple application of the DAC which requires no electrical background: computer music. I was very surprised to find that OSI offers a complete set of music programs for the C2-4P. To use these programs simply connect the output from the DAC to the input of an audio amplifier (the AUX input of a stereo will do nicely).

The programs have two operating modes: direct and programmed. In the direct mode, the user can play melodies from the keyboard, (i.e., pressing the "A" key generates an A, pressing "B" a B note, and so forth.) The programs have a three octave range, and produce a pleasant-sounding tone which can be adjusted using the bass and treble controls on the stereo.

An extended monitor is available for debugging assembly programs. It allows memory to be examined and altered, programs to be disassembled, and breakpoints to be set so that programs can be thoroughly tested.

Depending on the program selected, the output will be either single tones, or chords. (The latter program makes the computer sound much like a small chord organ.) Although not very versatile, the direct mode is fun for playing simple melodies, and for demonstrating the system to friends.

The second of the two modes is more powerful. This mode allows the user to type in a melody, using a simple system of letters and symbols to identify the various notes, have it stored on disk, and called back and played at a later time. The user is free to specify the tempo and the voice which the computer will use when playing back the melody. In addition, the programs allow for editing the score, either by changing or adding notes or by changing the tempo.

The most complex music program allows for multi-part, multi-voice composition. The user may enter up to four parts, and select a voice for each. Several multi-part compositions are included for demonstration.

The OSI music programs give the average person an excellent chance to experiment with simple composition, without having to spend extra money on those music boards and other hardware add-ons which must be purchased to allow other computers to make music. (I must emphasize that there are restrictions to the complexity of the music that can be produced through a single DAC with no external circuitry, and that these restrictions make the C2-4P music programs impractical for accomplished musicians.) Of course, for those who are (or become) more interested in electronic music, the computer can still be connected to external synthesis equipment to provide powerful and convenient control at a relatively low cost.

Graphics

The graphics capabilities of the C2-4P are impressive and relatively easy to use. The display is full-color, upper and lower case with additional predefined graphic character set. Several operating modes are selectable, including black and white (for programming or other tasks which do not require color), and double-width character display in which 32 large characters are printed across each line (instead of the usual 64.) On a good television or monitor, readability is not normally a problem, but a run-of-the-mill television may not perform very well.

The choice that OSI made between a predefined graphic character set and an infinitely variable one (by using separately addressable dots) represents a tradeoff between convenience and power. Although a high-density array of dots, each individually accessible, would allow excellent definition and detail, it would also pose significant programming problems. Instead, OSI equipped the C2-4P with a standard set of 256 symbols (including the usual letters and numbers) which can be combined to yield lines, boxes, spaceships, and other figures.

The graphics are memory-mapped, which means that the display screen looks like a block of memory to the computer. To access a given character position on the screen, simply deposit into the corresponding memory address via the Basic POKE statement. (Several charts are included in the documentation which show the locations in memory that correspond to display positions.) I find this less convenient than the "PRINT AT" and similar statements used by other computers; however, it is still manageable. Furthermore, if specific placement of output is not required, the standard PRINT statement can be used, and the keyboard/display will behave exactly like a normal terminal, complete with scrolling.

There are several graphics software packages which can be purchased from OSI for the C2-4P. The first of these allows the user to draw dots and lines on the screen using different colors. For example if the command "PLOT 1,1 TO 10,10" is given, the computer draws a line connecting a point in the first row, first column to a point in the tenth row, tenth column. A scale is printed on the screen to aid the user in identifying points; this can be removed when the final drawing is complete, if desired. Colors can be specified using the "COLOR" command. Once the desired pattern has been drawn, the entire screen can be saved on the disk for later recall and/or editing.

Since the recall of pictures from the disk is very fast, color cartoons can be developed which move at one frame per second or slower. For instance, an educational program could be interspersed with pseudo-animation to keep a young student's attention.

Naturally, one of the most common graphics applications is entertainment, and OSI supplies many games which take advantage of the C2-4P's video capabilities. Although most of the games are fairly average, there are some unique qualities worth mentioning. First, most of the games operate in real time and will allow several players to participate. This is really great for parties; besides, it keeps one sociable. (Why talk to the spouse or neighbors, when the computer's always ready to play games?) This way, you'll have to make a few friends, or at least make a few enemies that are willing to pit their skills against yours.

Most of the games operate in real time and will allow several players to participate.

Second, some of the games are actually challenging, so you won't lose interest after the first fifteen seconds. Sometimes I honestly wonder whether the world's game programmers aren't a mass of frustrated anaesthesiologists. Of course, even the worst and most pitifully boring computer game is better than television.

For the more serious-minded, there is an outstanding function-plotting package. Programs are supplied to plot functions in a single variable, along with parametric equations. To use, simply enter the function and the limits between which you wish to examine it. The computer takes care of axis location, scaling and labeling, and produces a highly readable plot. The whole process is foolproof; even if a function goes to infinity between the specified limits, the program does not fail, and the plot produced is correct.

This package would be excellent for high-school math as it would give students a direct look at the behavior of functions which may at first appear to be somewhat mysterious.

About the only disappointing thing I can say about the C2-4P's graphics is that OSI doesn't supply enough software which fully utilizes them. For instance, color and

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C2-4P, cont'd. . .

graphics make almost any program easier to use and could be more extensively applied to many of the software packages. Perhaps in the future this will be done.

System Software

System software refers to programs which aid the user in implementing his own applications on the computer. Standard system software supplied with every C2-4P system includes the OS-65D disk operating system and Microsoft Basic.

Microsoft Basic for the 6502 processor is fast and memory-efficient, but it does not offer many extended features compared with most of today's Basic interpreters. For example, lower-case commands are not accepted, and program editing is inconvenient, since there are no EDIT or RENUMBER commands. Both random and sequential-access files are supported, although the random-file commands are complicated and not very easy to use. Also, no provision for formatted printing was made. To put it simply, developing your own software on the C2-4P is not as easy as it is on other systems with more powerful Basic interpreters. This could be a major disadvantage if you anticipate writing all or most of your own programs.

The choice that OSI made between a predefined graphic character set and an infinitely variable one represents a tradeoff between convenience and power.

On the positive side, C2-4P Basic retains nine digits of precision during numerical calculations, and loads almost instantaneously from the disk. Also, programs can be stored and loaded quickly. Furthermore, Microsoft has adhered strongly to the ANSI standard, so that programs from books or other machines can be converted to run on the C2-4P with a minimum of fuss.

The other system program provided is the disk operation system, OS-65D, which takes care of disk operations such as file creation, storage, retrieval, formatting and other functions. It does this in two ways: through Basic programs, and through a machine code program known as the kernel.

When the system is first turned on, Basic is loaded and a program called "BEXEC*" is executed. This program sets various system and I/O flags, informs the user of the version of software currently running, and asks whether the system is to be "unlocked" or left "locked." In the locked mode, programs can be loaded and run, but they cannot be listed or modified. In the unlocked mode, Basic functions normally.

CHALLENGER

The file "BEXEC*" can be modified so as to cause execution of any other Basic program upon system startup. This is handy for end users, since they need not even concern themselves with finding a program in the directory, loading and running it; all this will be performed automatically.

Advanced file manipulations are handled by Basic programs; these include the creation, deletion, copying and renaming of files. For example, to create a file the user would type RUN "CREATE" while in the Basic command mode. This would load and execute the CREATE program which would then prompt the user for the filename and other information.

There are advantages and disadvantages to coding file utilities as Basic programs. On one hand, they are highly interactive; the computer asks for each piece of information and usually allows for final verification. This keeps inexperienced users from making catastrophic errors. On the other hand, the Basic utility programs take up room on the disk and are slow in many cases. Customizing them, except for an experienced programmer, is virtually impossible due to the condensed manner in which the programs are written. Furthermore, one cannot perform file operations while maintaining a Basic program in memory (easily), since running any of the file utilities wipes out whatever program is currently in the workspace.

As I mentioned, there is a second mode of operation of OS-65D called the kernel. This mode can be reached from Basic by typing "EXIT." From the kernel, low level disk manipulations can be performed, such as the initialization of new disks, copying from one disk to another and other primitive functions. It is also from the kernel that the assembler/editor and extended machine-language monitor are invoked (more about these later).

One particularly annoying aspect of OS-65D is that the user must decide the physical location and length of each file when it is created. This is completely unnecessary. If the C2-4P is designed for end-users rather than professional programmers or computer engineers, it should not be necessary for users to be familiar with the intricacies of floppy disks, i.e., the location of tracks, sectors and the like. Furthermore, this could easily be changed. The OS-65U operating system available on larger OSI machines takes care of file allocation automatically. This is certainly feasible for the C2-4P, and a change in this area would make the system much easier for the average person to use.

Assembly Language Programming

I mentioned earlier that the assembler/editor and extended machine code monitor could be invoked from the kernel mode of OS-65D. These programs allow the development of low-level software in 6502 assembly code.

The assembler and editor are coresident — a handy feature. This means that it is possible to run the editor, enter a program and have it immediately assembled. If any errors are present, the user simply changes the program and reassembles. There is no need to run separate editor and assembler programs (which would involve reading and writing disk files and other time-consuming operations).

An extended monitor is available for debugging assembly programs. It allows memory to be examined and altered, programs to be disassembled, and breakpoints to be set so that programs can be thoroughly tested. A host of other convenience features are also available,

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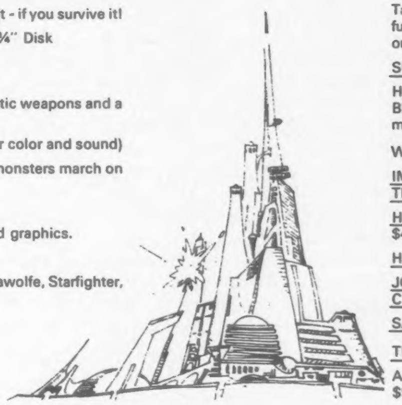

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C2-4P, cont'd. . .

such as a hexadecimal calculator mode and a command which allows memory to be displayed as ASCII text. The only major option missing is a trace mode, whereby a program can be single-stepped with register contents and execution address printed after every instruction. Nonetheless, the extended monitor is one of the more powerful pieces of debugging software I've come across.

Data Management Software

OSI supplies, at additional cost, a set of programs which aid users in organizing data, called the Micro Database Management System, or OS-MDMS for short. The purpose of MDMS is to facilitate the creation of data bases — files on disk filled with information organized so that it can be easily retrieved. An example of a data base would be a list of names, addresses, phone numbers, birthdays or other pieces of information concerning family members or friends. This list could be entered into a computer file via MDMS. Once the file has been filled, MDMS could then answer questions on its contents. For instance, the computer could be asked to find and print all names which correspond to a given phone number. Reports on the data file can also be printed; MDMS can select specific entries from a file and list their contents in a report of user specified form.

The most complex music program allows for multi-part, multi-voice composition. The user may enter up to four parts, and select a voice for each.

The main advantage of MDMS is that it requires no knowledge of programming. The computer prompts for all required information; if the user is confused, there are plenty of examples and operating hints in the MDMS documentation. Also, new data files can be created and filled in a very short period of time. Although I have not used MDMS extensively, I have had occasion to use its big brother, OS-DMS quite a bit. This is a more extensive version of MDMS, which is available on the larger OSI systems. I was pleasantly surprised at how quickly an idea could be turned into reality. Within about a half hour of receiving OS-DMS I had a fully operational data base of names and addresses of people who had inquired about some of my past articles — with no programming whatsoever. I found the MDMS version just as easy to use.

Another advantage of MDMS is that it can handle a wide variety of applications — from lists of names and dates to lists of checks, bills and almost anything else that can be described in an organized manner. Since the same program, OS-MDMS, is used to control all the data bases the inexperienced user needs only to familiarize himself with the MDMS commands. This is in contrast to a situation where a different program is used for every application — say, a shopping list program, a bill record keeper, a name and address program, and others; in this case, the potential user must learn the ins and outs of a number of different programs, which can be quite a formidable task to someone not familiar with computers.

As with all programs, MDMS has its drawbacks. In order to be easy to use, it must make assumptions that limit its flexibility. If it were programmable, it would be more flexible and could handle more data storage applications; unfortunately, it would also be more complicated. As a compromise I feel that a more powerful report generator should be incorporated into MDMS, as this appears to be the weak link in the chain. Although the present report capability is easy to use, and adequate for many simple tasks, it is too restrictive to be used for complex applications. Some form of programming should be allowed so that the more experienced user can organize output more carefully. If this were done, OSI's data base systems would be really excellent for dealing with the types of information problems that personal computer owners are trying to solve.

Business Applications

You may have noticed that I haven't mentioned the C2-4P with respect to small business computing. There is a reason for this. The C2-4P is basically a small machine — it was designed that way. Although Accounts Receivable, Accounts Payable and other business programs are available for it, by itself the C2-4P does not have the kind of storage capacity or flexibility needed for a business environment. In addition, it has a lot of features the businessman doesn't need. In short, someone intent on mainly business computing would be better off considering a larger system such as the OSI Challenger III series. These computers can run more powerful languages such as Cobol and Fortran, can physically accommodate more expansion in terms of memory, hard disks and other equipment, and yet are still within the average business' budget.

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Networking

There is a new area of computing that OSI is just beginning to develop; this has to do with connecting groups of small computers together in a network to share storage and input/output resources.

The basic goal of networking is to allow many people access to computing facilities simultaneously. In a classroom, for example, it would be desirable to allow several students computing time together. The traditional answer to this problem has been timesharing — the division of a single computer's time between many different tasks. This has a drawback — the more tasks the computer must accomplish at once, the smaller the amount of time it can devote to each one.

One particularly annoying aspect of OS-65D is that the user must decide the physical location and length of each file when it is created. This is completely unnecessary.

Networking looks at this problem from another standpoint. Instead of forcing one central computer to service all the users, several smaller computers are connected together — or to one larger unit equipped with large amounts of storage and several printers. One small computer is available for each individual user. This computer communicates with the larger one to access data on the disks, or to output data to a printer or other device. Otherwise, all processing is done locally at the user's own small unit. This scheme offers a great many advantages over timesharing; however, in the past it was too expensive to consider. Now, with the advent of the C2-4P and other inexpensive small machines, networking is a definite possibility.

In this context, the C2-4P does have a potential business use; connected to one of OSI's larger machines, it could be used to process orders, keep track of inventories, and perform other tasks which would be difficult if it did not have access to the facilities of the larger machine. This would result in a setup far better than timesharing, yet still be less expensive than many of the traditional minicomputers used for business.

As I have mentioned before, this is a new area which OSI is still developing;

since major advances come every few months, it would be best to contact Ohio Scientific to see exactly what is available in terms of hardware and software.

Documentation

Plenty of documentation is provided but it is not well organized, particularly the Basic manual. This stems from the fact that system literature is generally used for two purposes: first, to help the new user familiarize himself with the operation of the software; second, to act as a reference for syntax.

It would be preferable if OSI were to print two sets of documentation for each software package: a reference guide and a usage tutorial. A new user would read through the latter to become familiar with the software, and consult the reference guide for specific syntax format. Currently, OSI provides manuals which are combinations of the above; this makes finding pieces of information regarding system operation extremely difficult, since it is necessary to wade through text and examples to find specific formats of commands and/or operations. If separate user and reference guides are impractical, at least a more comprehensive index should be provided.

Now, with the advent of the C2-4P and other inexpensive small machines, networking is a definite possibility.

Another questionable aspect of the documentation is the primer on Basic programming. Although helpful in many ways, it is far from complete; I think customers would be better off if they were provided with one of the many books on programming in small-computer Basic currently in print. After all, OSI provides a separate text on assembly-language programming with its Challenger III series computers. I feel the same idea would work well with Basic, especially since Microsoft Basic follows the ANSI standard so closely. In addition to the book, the user could be provided with a manual describing the extra features available on the C2-4P, such as disk file access, graphics, etc.

A further, albeit less serious problem with the documentation is the manner in which it is reproduced. Print quality varies from invisibly light to unreadably dark and smeared. I realize that OSI does not believe it is in the publishing business; however, I think that most people would be willing to pay a higher price for typeset, book-quality manuals produced by a standard publishing company, since this would result in both a more readable and a more durable copy. After all, a computer manual to a programmer is like a dictionary to a writer: it is consulted almost constantly, and the information contained within is critically important for proper usage. Some extra effort spent in this area would definitely make the system easier to use.

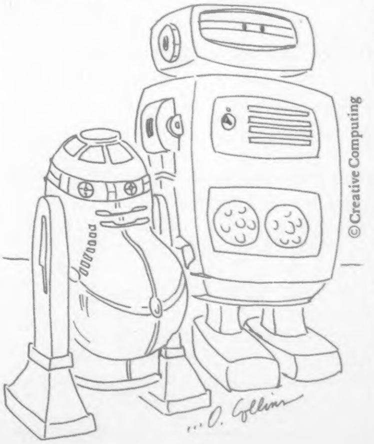
Service

One of the biggest problems in buying any type of small computer today has to do with communication between the customer and the company concerning malfunctions and hardware/software updates. My advice to purchasers of the C2-4P and other OSI equipment is to find a good dealer located a reasonable distance away. At least at the time of this writing, OSI is not keen on dealing directly with customers; all service, installation and instruction is handled by authorized dealers. Furthermore, since much of Ohio Scientific's equipment is state-of-the-art, there will inevitably be problems. A local, reputable dealer can handle these problems with a minimum of inconvenience; otherwise, some real headaches could result.

Of course, this situation is common with many computer manufacturers; my point is that perhaps the most important step towards owning a powerful, trouble-free personal computer is the careful selection of a responsible, knowledgeable dealer who is willing to sit down and discuss aspects of the system with the user when necessary.

Conclusion

Like most machines, the C2-4P has both good and bad points. As I stated in the introduction, I feel it has many unique features which are unobtainable in any other computer in the same price range. However, it is up to each prospective purchaser to formulate an idea as to exactly what he or she expects a personal computer to do. Afterward, the advantages and disadvantages of the C2-4P can be weighed, and a decision can be made as to whether or not this particular machine will fill the bill. □



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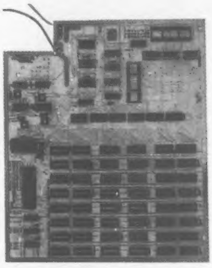
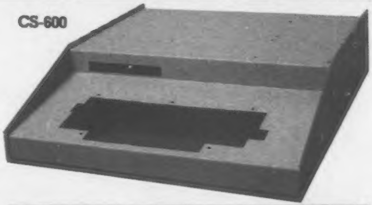


610 Board

CS-600



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C1P Sams	C1P/Superboard II Manual.	8
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creative computing
EQUIPMENT PROFILE

Sound Advice

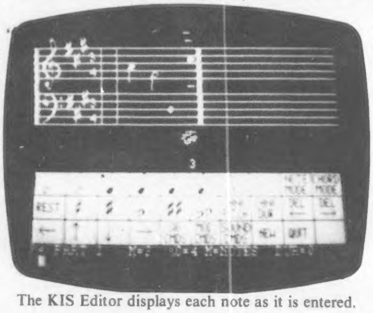
David Lubar

Computer music in the home has come a long way since the days when hobbyists placed an AM radio by the spacebar and listened to the sound of loops. There are more than a dozen systems available now, with prices ranging from around $100 to well over a $1000. Before looking at some of the new systems, it would be worthwhile to go over some definitons and guidelines. First, most systems are based on the use of a synthesizer. A few systems use digital-to-analog converters (DAC's). A synthesizer contains the hardware needed to generate a waveform. A DAC converts binary information into a variable voltage. Synthesizers have several good points; they allow high fidelity, they allow a large number of voices, and they use less memory since much of the work is done by the hardware. On the other hand, many synthesizers are limited to only one waveform. The next generation of synthesizers will have more versatility. Still, even those restricted to a single waveform can do an excellent job. DAC's also have some advantages; great versatility as far as output is concerned, simpler electronics (which means lower prices), and the potential to be adapted for other uses. Their disadvantages include less fidelity, a tendency to produce clicks (which can be filtered in either hardware or software), more use of memory space since all the work is done in memory, and a limit to the number of voices that can be played at one time. Faster processors will soon be put to use, allowing for more voices.

Whether you choose a synthesizer or a DAC, important factors will be how much you want to spend and how much can you get for your money. The professional musician will have different needs from the user who just wants something with which to experiment. Another consideration is whether the company you select gives continued support and provides a source of new material. With this in mind, on to the reviews.

Mountain Hardware

The long-awaited system from Mountain is finally available. The ads mentioned a lot of very exciting specifications, including sixteen voices and programmable waveforms. For the most part, the system fulfills these promises. But at $545, the system may be a bit high-priced for some hobbyists. The hardware consists of two boards which must be plugged into consecutive slots on the Apple. Any slots other than 0 can be used. Apparently, the software checks the slots; the user doesn't have to input the slot numbers. Attached to the board are two phono jacks (plugs and cords are included) and a light pen. The light pen is used for menu selection and note entry, and works best when held slightly away from the screen instead of being pressed against the glass.



The KIS Editor displays each note as it is entered.

Since anyone who buys the system will want to hear it right away, Mountain included several songs on the disk with the system. This, by the way, is a double-sided disk; the song files are on the back.

To play a song, the user selects the play option with either the light pen or keyboard. The system will ask for the song name. The disk has to be flipped. Then the comp file is loaded and options are presented for changing the instrument assignments, the stereo pattern, and other parameters. Once any desired changes have been made, the disk is flipped again and the system compiles the music. This takes a minute or so, after which the music plays. The sound quality is impressive.

Music is entered with paddles or light pen by selecting options from a graphic menu. The first step is selection of a key signature. Once this is done, notes can be entered. All sharps, flats, dotted notes, and other parts of the score are all entered from the menu with light pen or paddles. Parts can be merged, up to the allowable sixteen voices. There is a provision for entering chords in any part, but the total number of notes played at any time must still be sixteen or fewer. Once a song is finished, it can be compiled and played. If it is saved in a comp file, it can be changed and then compiled. In a play file, it can be played immediately, or changes can be made.

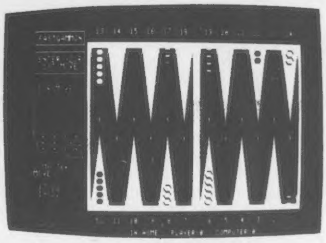
Since the system uses digital oscillators, the waveform can be controlled through software. A table of 256 bytes defines each waveform, and the user can construct and save new waves. This method allows for a great deal of versatility in sound production.

The manual contains all the information needed to get going. The system is nice and is backed by Mountain's good reputation in the hardware field.

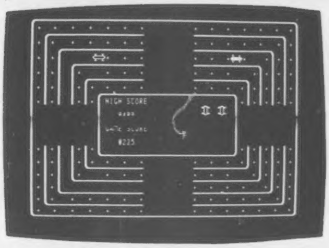
American Micro Products

A synthesizer board and two software packages for 48K Apples are available from this company. The board ($99.95) contains three voices and one white-noise channel. One software package, *Flash and Crash Sound Effects*, has a sound effects

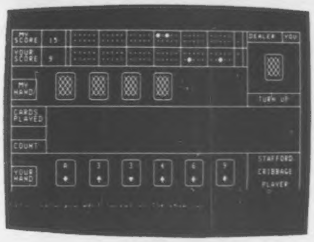
SOFTWARE FOR THE SORCERER*



FASTGAMMON



HEAD-ON COLLISION



CRIBBAGE

UTILITY PROGRAMS

FORTH. Now Sorcerer owners can enjoy the convenience and speed of the fascinating FORTH programming language. Based on fig-FORTH and adapted for the Sorcerer by James Albanese, this version uses simulated disk memory in RAM and does not require a disk drive. Added to standard fig-FORTH are an on-screen editor, a serial RS-232 driver, and tape save and load capability. Eight-bit input/output has been added allowing use of the Sorcerer's graphics keys Documentation includes examples. Requires 32K or more of RAM. **$49.95**

new! BEDIT by Ernest Bergmann. A BASIC editor. This short and easy to use program is a machine language routine that loads in low memory and allows you to edit your BASIC programs by modifying text on the video screen. No more retyping a long line just to change one character. A few cursor movements make the necessary modifications. Even renumbering lines is easy to do. This program is a real timesaver. Runs on any size Sorcerer. **$11.95**

new! GRAPHICS ANIMATION by Lee Anders. This package provides the BASIC programmer with a powerful set of commands for graphics and animation. The program is written in machine language but is loaded together with your BASIC program and graphics definitions with a CLOAD command. Any image from a character to a large graphic shape may be plotted, moved, or erased with simple BASIC commands. Encounters of plotted character sets with background characters are detected and background images are preserved. Contains a medium resolution plotting routine. A keyboard routine detects key presses without carriage returns. Includes a separate program for constructing images. Runs on any size Sorcerer. **$29.95**

QS SMART TERMINAL by Bob Pierce. Convert your Sorcerer to a smart terminal. Used with a modem, this program provides the capability for you to communicate efficiently and save connect time with larger computers and other microcomputers. The program formats incoming data from time-sharing systems such as The Source for the Sorcerer video. Incoming data can be stored (downloaded) into a file in RAM. Files, including programs, may be saved to or loaded from cassette, listed on the video, transmitted out through your modem, or edited with an on-board text editor. Interfaces with BASIC and the Word Processor Pac. **$49.95**

DPX™ (Development Pac Extension) by Don Ursem. Serious Z80 program developers will find this utility program to be invaluable. Move the line pointer upward. Locate a word or symbol. Change a character string wherever it occurs. Simple commands allow you to jump directly from EDIT to MONITOR or DDT80 modes and automatically set up the I/O you want for listings. Built-in serial driver. Stop and restart listings. Abort assembly with the ESC key. Save backup files on tape at 1200 baud. Load and merge files from tape by file name. Versions for 8K, 16K, 32K, and 48K Sorcerer all on one cassette. Requires the Sorcerer's Development Pac. **$29.95**

PLOT by Vic Tolomei. Now Apple owners will be envious of how easy you can get good graphics on your SORCERER. PLOT includes both a super high resolution mode and a quick low resolution mode. Both are accessible from your BASIC programs using simple commands. Hi-res & lo-res examples included on tape. **$14.95**

SHAPE MAKER™ by Don Ursem. An on-screen character maker. **$14.95**

DEBUG by Bob Pierce. Debug machine language programs. **$14.95**

SIMULATIONS AND GAMES

new! CRIBBAGE by Bob Stafford. The computer challenges you to a game of cribbage. An excellent use of graphics displays the cribbage board and all the playing cards. The computer pegs the score, computes all the counts, and plays the good game, adhering strictly to the rules of standard cribbage. Beginners will find it easy to learn the game by playing against the computer, and experienced players will enjoy trying to outsmart the computer with crib layaways and careful play. Requires at least 16K of memory. **$17.95**

STARBASE HYPERION™ by Don Ursem. At last, a true strategic space game for the Sorcerer! Defend a front-line Star Fortress against invasion forces of an alien empire. You create, deploy, and command entire ship squadrons as well as ground defenses in this complex tactical simulation of war in the far future. Written in BASIC and Z-80 code. Full graphics and realtime combat status display. Includes full instructions and STARCOM battle manual. Requires at least 16K of RAM. **$17.95**

HEAD-ON COLLISION™ by Lee Anders. You are driving clockwise and a computer-controlled car is driving counter clockwise. The computer's car is trying to hit you head on, but you can avoid a collision by changing lanes and adjusting your speed. At the same time you try to drive over dots and diamonds to score points. Three levels of play, machine language programming, and excellent graphics make this game challenging and exciting for all. At least 16K of RAM is required. **$14.95**

LUNAR MISSION by Lee Anders. Land your spacecraft softly on the moon by controlling your craft's three propulsion engines. Avoid lunar craters and use your limited fuel sparingly. You can see both a profile view of the spacecraft coming down and a plan view of the landing area. Land successfully and you get to view an animated walk on the moon. Nine levels of play provide a stiff challenge to the most skillful astronaut. Requires at least 16K of RAM. **$14.95**

new! HANGMAN/MASTERMIND by Charles Finch. Two traditional games are brought to life by Sorcerer graphics. HANGMAN has three different vocabulary levels for you to choose from. In MASTERMIND, the computer selects a four-character code and you have to uncover it. These two games provide an enjoyable way for young people to develop their vocabulary and their logical reasoning ability. Written in BASIC, for any size Sorcerer. **$11.95**

FASTGAMMON™ by Bob Christiansen. Backgammon players love this machine language program that provides a fast, skillful opponent. Option to replay a game with the same dice rolls. Eight-page instruction manual includes rules of backgammon. **$19.95**

MARTIAN INVADERS™ by James Albanese. How long can you hold out against a persistent invasion force from Mars? Zap all the members of the landing party and another group comes after you. The longer you hold out, the higher your score. The Sorcerer's programmable graphics make this game look great, plus we've added special keyboard routines to really zip it up. Written in machine language. **$14.95**

NIKE II™ by Charles Finch and Bob Broffel. You may never get your computer back from your kids once they start playing Nike II. The object is to destroy enemy bombers by firing Nike missiles at them. If you miss the bombers, they bomb your factories and return for a second pass. Nine levels of play make this game a challenge for everyone. Written in machine language. **$11.95**

Z80 DISASSEMBLER by Vic Tolomei. Decode machine language programs. **$14.95**

SOFTWARE INTERNALS MANUAL FOR THE SORCERER by Vic Tolomei. A must for anyone writing software for the SORCERER. Seven chapters: Intro to Machine Language, Devices & Ports, The Monitor, Cassette Interface, BASIC structure, Video & Graphics, The Keyboard. Indexed. Includes diagrams and software routines. 64 pages. **$14.95**

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WHERE TO GET IT: Ask your nearest Sorcerer dealer to see *Quality Software's* Sorcerer programs. Or, if you prefer, you may order directly from us. MasterCharge and Visa cardholders may telephone their orders and we will deduct $1 from orders over $19 to compensate for phone charges. Or mail your order to the address above. California residents add 6% sales tax. *Shipping Charges:* Within North America orders must include $1.50 for first class shipping and handling. Outside North America the charge for airmail shipping and handling is $5.00 — payable in U.S. currency.

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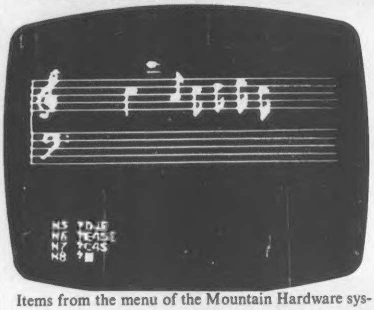
TANK TRAP by Don Ursem. An action game that combines skill, strategy, and luck. A rampaging tank tries to run you down. You are a combat engineer, building concrete barriers in an effort to contain the tank. Four levels of play make this animated game fun for everyone. Written in BASIC with machine language subroutines. **$11.95**

MAGIC MAZE™ by Vic Tolomei. A challenging maze game. Ten levels of play. Holding your lantern, you wander through a maze trying to stay on the right path and avoid pitfalls. Automatic scoring tells you how good a pathfinder you are. **$11.95**

CIRCLE 178 ON READER SERVICE CARD

Sound, cont'd. . .



Items from the menu of the Mountain Hardware system can be selected with paddles or a light pen.

demo and documentation that shows the user how to add sound effects to his own software. Once the synthesizer is switched on, sound production is continuous. This means that it won't slow down a program. The *KIS Music Editor* ($39.95 by itself, $129.95 for *KIS* and a synthesizer) uses symbolic note entry. For example, a quarter note that was a C in the third octave would be entered as C4Q. As each note is entered, it is displayed on a high-resolution staff and played through the board. Envelope control is available through sixteen defined envelopes that can be entered along with the note code. The sound quality isn't bad, and some interesting variations are possible. A jukebox program is also on the disk, allowing for the selection and play of up to ten songs. Editing of scores is fairly simple; any note can be accessed and changed.

The boards contain drivers so they can be connected directly to eight-ohmspeakers without any need for an amplifier. The boards can be combined, with each board adding three more voices. American Micro Products seems to be constantly working on new products, and they are very open to questions from users.

AlphaSyntauri Ltd.

Most music systems are not oriented toward real-time creation; in other words, you put the music in at your leisure and it comes back later. The AlphaSyntauri system allows real-time creation of music. The system consists of a keyboard and software for Apple II and Apple II plus. The user must supply his own sythesizer boards. Presently the software is configured for use with ALF boards.

One of the main features of the keyboard is velocity sensing. The speed with which any of the 61 keys is pressed controls the amplitude of the note. Since the interpretation of the keystroke is done through software, the potential exists for customizing the keyboard, using it to enter other types of input. There are also two footpedals attached to the unit. The sound of any system will only be as good as the synthesizers. In this case, with ALF boards, the sound is very good. Besides live play, notes can be recorded on disk and replayed with different tempos. Notes can be appended to an existing score, though no editing function is available with the current software.

The software contains presets. These are defined envelopes which control six parts of the sound, including attack rate, attack volume, decay, and sustain. Eight presets come with the disk, and more can be created and saved by the user. The display consists of low-resolution graphics with bars that rise and fall according to the volume of the notes. There is a second display which gives the names of the notes being played. The system can handle six notes at a time. When more than six are struck, the bass is kept and the next-to-last high note is dropped. This works well since most music requires more sustain from the bass.

The Alpha Syntauri — outstanding in its field.

The system is nicely designed and comes with good documentation, including a thorough explanation of amplitude envelopes. The price puts it out of range of the casual user, but not beyond reach of those seriously interested in music. The AlphaSyntauri, without ALF boards, costs $1295. It should be interesting to see what happens to this price when other manufacturers enter the market.

Micro Technology Unlimited

As you may have noticed, all of the systems mentioned so far are designed for use with the Apple II. Those who own other computers do have one rather nice option. MTU makes a general 6502 music system which can run on the PET, KIM, and others. The software is $49.00. KIM DAC's are $49.00, PET versions are $59.00. The software can also be configured for the Apple (such a version is currently under development). The system uses a DAC and produces some amazing results. The user has control over every aspect of the waveform; the shape of each harmonic can be specified. This allows duplication of most instruments as well as the creation of new sounds. Once a set of waveforms has been defined, instruments can be constructed which use the waveforms. The instrument can be constructed with warble and other factors. Four voices are available. With one DAC, the user has monaural music. A second DAC won't increase the number of voices, but it will allow stereo music.

The degree of waveform control leads to interesting results. For example, a set of waveforms constructed with no fundamental and with 2nd, 3rd, 4th, 5th, 6th, and 8th harmonics coming in one at a time will produce the sound of a full chord even though only one voice is being used. Control of the instrument envelope also produces interesting results. An instrument can be created which plays the waveforms from back to front, or which repeats the opening section of another instrument, thus sounding like a mandolin. The number of waveform sets is limited only by available memory. A 32K system could easily handle four to six large sets of waveforms and up to fifteen instruments.

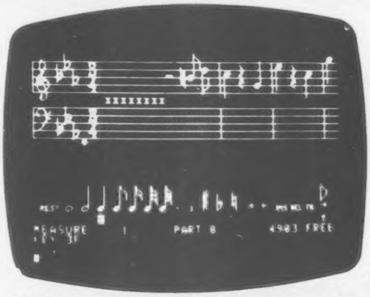
Presently, all information is entered as numerical data. This is not a big drawback since anyone can quickly learn to use the system with the aid of the excellent manual written by Hal Chamberlin. MTU is working on a software interface that will allow other methods of note entry. Those who are interested in the DAC approach shouldn't wait, but should check out the MTU system and see for themselves how well it works.

Updates and Other Notes

Micro Music, Inc. has released *The Melodious Dictator* ($120), a program designed for ear training. At the start, the user enters his competence, from 1 to 6. A dry run shows how to use the system. A series of notes are played. The user, given the first note, must notate the rest of each sample. This is done with a paddle which moves a cursor above a section of a graphic keyboard. Unfortunately, the cursor doesn't respond very well. It blinks at a slow rate and only moves between blinks. A turn of the paddle produces no immediate results. Then, suddenly, the cursor jumps over. It might jump again before settling on a spot. This is a small problem, but might frustrate those who are more interested in music than computer graphics.

The rest of the program is well designed. A scoring system gives points for correct notes and adjusts the skill level according to performance. The key of the scale changes with each test.

So, aside from the problem with the cursor, the program is well designed. But does it work? In my case, it did. At first, I was unable to pick the right notes without many mistakes. In essence, it was a game of "Guess the Number," where the correct answer was found by narrowing down the possiblities. After a while, I began to do better, even recognzing minor thirds and other difficult (for me) intervals. The system definitely can help improve musical perception. If you want to improve your ear, and don't have a friendly pianist handy, *The Melodious Dictator* could provide a helping hand.



The ALF software displays the score as the song player.

Now for the big news. ALF has come out with a new board that puts music within reach of a many more Apple owners. The board has nine voices and sells for $199.95 with software. The original ALF system was reviewed in June 1979 and described in greater depth in June 1980. These new boards contain more voices at a lower price. Some sacrificies had to be made to bring the user this board. Sound quality in the two upper octaves is not as precise as in the other ALF boards and there are fewer volume increments. But anyone who wants to create computer music for a reasonable price could get a lot out of this system. ☐

Vendor Addresses

ALF/ Peripherals Plus
119 Maple Ave.
Morristown NJ 07960

American Micro Products
6550 Tarnef
Houston TX 77074

Micro Music, Inc.
University Plaza, Suite 8
309 West Beaufort
Normal IL 61761

Mountain Hardware
300 Harvey West Blvd.
Santa Cruz CA 95060

Micro Technology Unlimited
2806 Hillsborough St.
P.O. Box 12106
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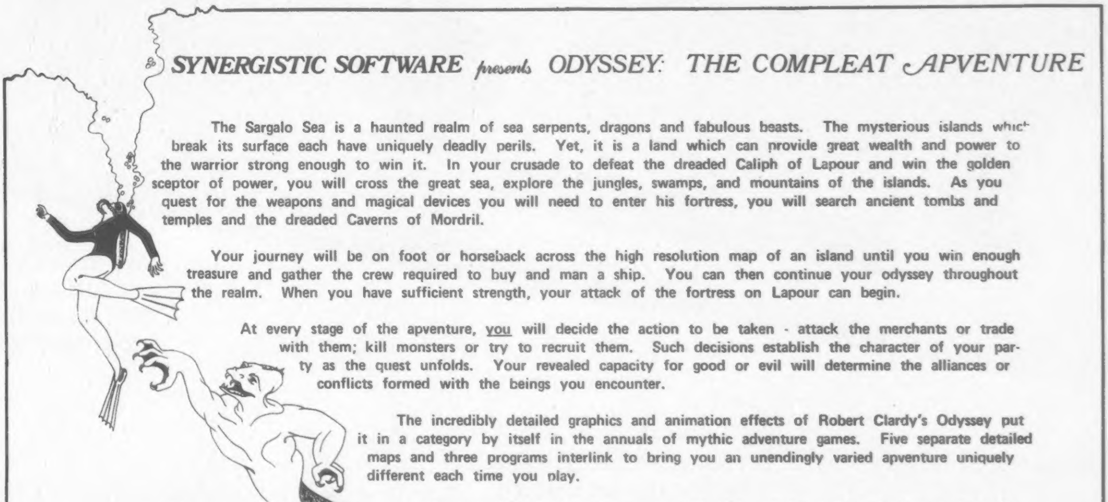
SYNERGISTIC SOFTWARE presents ODYSSEY: THE COMPLEAT APVENTURE

The Sargalo Sea is a haunted realm of sea serpents, dragons and fabulous beasts. The mysterious islands which break its surface each have uniquely deadly perils. Yet, it is a land which can provide great wealth and power to the warrior strong enough to win it. In your crusade to defeat the dreaded Caliph of Lapour and win the golden sceptor of power, you will cross the great sea, explore the jungles, swamps, and mountains of the islands. As you quest for the weapons and magical devices you will need to enter his fortress, you will search ancient tombs and temples and the dreaded Caverns of Mordril.

Your journey will be on foot or horseback across the high resolution map of an island until you win enough treasure and gather the crew required to buy and man a ship. You can then continue your odyssey throughout the realm. When you have sufficient strength, your attack of the fortress on Lapour can begin.

At every stage of the apventure, you will decide the action to be taken - attack the merchants or trade with them; kill monsters or try to recruit them. Such decisions establish the character of your party as the quest unfolds. Your revealed capacity for good or evil will determine the alliances or conflicts formed with the beings you encounter.

The incredibly detailed graphics and animation effects of Robert Clardy's Odyssey put it in a category by itself in the annuals of mythic adventure games. Five separate detailed maps and three programs interlink to bring you an unendingly varied apventure uniquely different each time you play.

Requires 48K Apple][computer with disk. Only available in Integer Basic for $30.00.

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CIRCLE 190 ON READER SERVICE CARD

9K RAM (8K user available), 14K BASIC interpreter operating system ROM.

User-programmable, in both BASIC and MC6800 machine language.

Built-in RF modulator.

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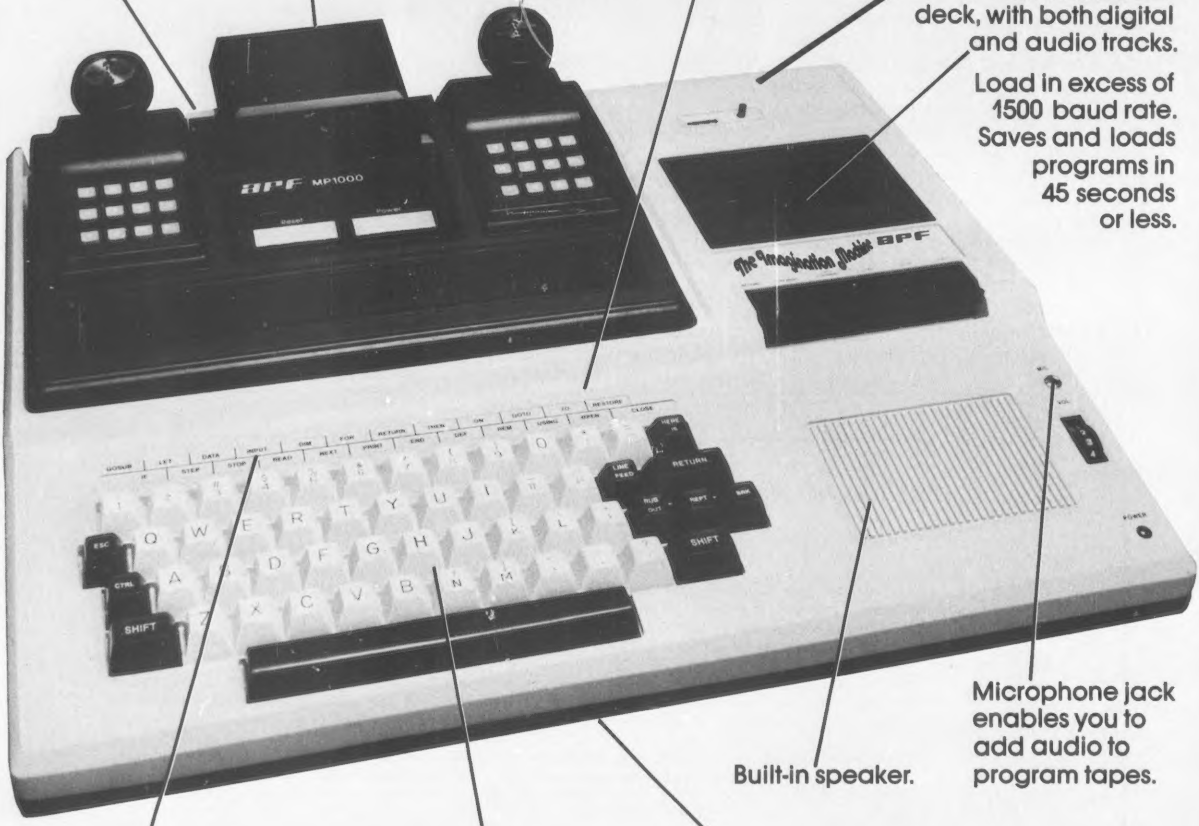
Load in excess of 1500 baud rate. Saves and loads programs in 45 seconds or less.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The Imagination Machine APF
RETURN
SHIFT
ESC
CTRL
SHIFT

Microphone jack enables you to add audio to program tapes.

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All that computer for $599.

The Imagination Machine, the personal computer from APF Electronics.

The Imagination Machine is more personal computer than you'd expect at $599.

The Imagination Machine is a superbly designed, expandable, user-programmable computer system…at $599.

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Read what it brings you:
First of all, The Imagination Machine has 9K RAM and 14K BASIC-IN-ROM. A full 53-key professional, typewriter keyboard. A high-resolution picture on your TV set, in eight colors. Fast loading (1500+ baud rate), built-in dual-track cassette deck, for APF's digitally recorded tape programs. Built-in sound synthesizer. And, even a built-in RF modulator, which is a $40 option on other computer systems.

All that, plus user-programmability.
We know sophisticated users aren't going to be satisfied forever using preprogrammed software. (Even though we offer a large library of educational, entertainment, home and business management programs.) So, we made The Imagination Machine user programmable, in both BASIC and MC6800 machine language. To simplify matters, we've just developed the first and only BASIC TUTOR course on cassette. With it, you can learn to program The Imagination Machine in BASIC, with hands-on training, right at the computer.

Some exceptional features.
The Imagination Machine has several unique features that can help you use your time at the computer more effectively.

For example, it stores programs and data on the same cassette tape. (With other computers, you have to read programs from one tape into the computer, remove the tape, put in another tape and store your data on the new tape.)

Another special feature is The Imagination Machine's unique keyword system, which simplifies BASIC programming. The machine has 24 different programs statements and commands printed at the top of the keyboard. You can enter these 24 into your program without retyping them every time you use them. Instead of typing out "PRINT," for example, you just press two keys and the word appears on the screen. The system helps prevent typing errors and can speed up entering programs.

A third feature is Timed Response Monitoring, which automatically adjusts the computer's pace and level to your own. It makes "tutoring programs," for instance, easier and more interesting to follow.

And then there are The Imagination Machine's three graphic display modes: 1. Alpha numerics, mixed with low-resolution graphics in as many as eight colors. 2. High resolution — up to eight colors — 128 x 192 display. 3. High resolution graphics — up to four colors — with 256 x 192 display.

And expandability.
A personal computer that can't grow along with your growing requirements soon becomes obsolete. So, we designed The Imagination Machine to be expandable. By adding APF's optional "Expansion Box" and interface cartridges, you can hook up any compatible floppy disk or printer, or an additional 8K RAM memory cartridge.

Full mini-floppy system $995.

For small business and professional use, you may require a full mini-floppy system. In that case, order APF's System II. It includes The Imagination Machine, the "Expansion Box," floppy disk interface and 72K-byte, mini-floppy disk drive. All for just $995! No one can come close to that price.

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creative computing
SOFTWARE PROFILE

Tuesday Night Football and Stellar Trek

Through Space And Turf on the Apple II Plus

David Lubar

Generally, it's nice to have a theme behind software reviews. In this case, there were some good games sitting around which really couldn't be tied together. Rather than wait for more games to come in, it seemed best to flaunt form and style by doing a themeless review. So, let the games begin.

Tuesday Night Football is a well-constructed game designed for one player. TNF (as its creator, Charles Anderson, calls it) contains several programs, including one for kicking practice. The human player has to do his own punting and make his own field goals. These feats are accomplished on a nicely-designed low-resolution field. The kicked ball rises up, wobbles against air currents, then drops down field. A bit of skill is required to get a decent kick.

During the game, the player has a choice of many different offense or defense moves. The field is displayed as a grid on the text screen, populated with X's and O's. Don't let the lack of animation hold you back. Mr. Anderson, having the option of designing an animated, paddle-controlled, limited game or a strategic contest, wisely chose the second option. This is a thinker's game, demanding strategy and skill.

Each play is given with color commentary. A scoreboard, first down marker, and ball marker are displayed during play. The game is rich in detail and variety. There are injuries, penalties, and fumbles. The player has to react quickly to recover a fumble. There is also a marker on the scoreboard that indicates which team has momentum.

The documentation is great. It is written in a pleasant, humorous style, not cranked out by someone in love with jargon. Instructions are included for changing the DATA statements so any two teams, real or imaginary, can play. ("Kirk hands off to Plato who is tackled by Capote and Mailer."

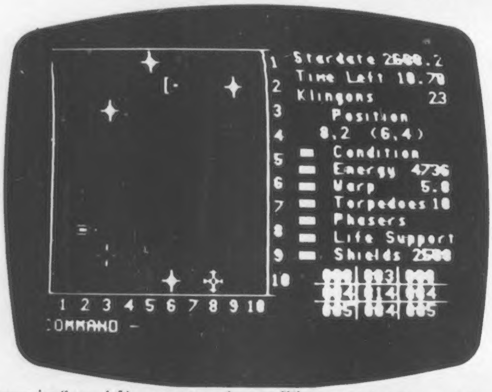
TNF is too rich in detail to be fully described here. If you like football, give it a try. TNF comes on cassette for $13.95 and on disk for $17.95. If you order directly from ShoeString Software (1235 Candlelight, Houston TX 77018) there is an additional charge of $1 for postage and handling. The game requires Applesoft in any flavor and 26K of free memory.

After a hard game of football, you can command another team in *A Stellar Trek* from Rainbow Computing. The program boldly goes where no Trek has gone before, allowing an incredible number of options. The game is thorough and challenging. A high-resolution display, mixing graphics and text, depicts the Enterprise and other vessels in full color. Animation is used whenever the ship moves or fires a weapon. The numerous commands are explained in 22 pages of instructions. Among the commands are options which allow the player to beam down a crew and mine dilithium crystals. How's that for detail?

At the opening of the game, you get to choose the names of the crew members. Trek aficianados can stick to the correct nomenclature; deviants can be as sacrilegious as they want. The names are saved on the disk for use in later games. There is a choice of game length, skill level, and regular or tournament play. Tournament play allows several persons to play, one at a time, against the same setup. In this mode, identical actions will produce identical results.

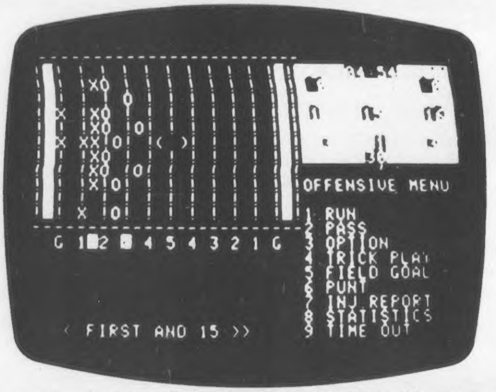
At any point, a game in progress can be saved. While Rainbow suggests that the other side of the disk can be used to save the game, this is not a good idea. Considering the minimal cost of disk space, and the chance of losing data by using both sides, it's better to splurge and save the game on a different disk.

That's it for the reviews. Perhaps there is a theme after all; both games are the result of hours of work, careful programming, and nice touches. □



```
Stardate 2600.2
Time Left 10.70
Klingons      23
   Position
 8,2  (6,4)
   Condition
   Energy  4736
   Warp     5.0
   Torpedoes 10
   Phasers
   Life Support
   Shields 2500
COMMAND -
```

The Enterprise (lower left) prepares to take on a Klingon vessel at the top of the screen.



A delay-of-game penalty put the offense in trouble in this scene from TNF.

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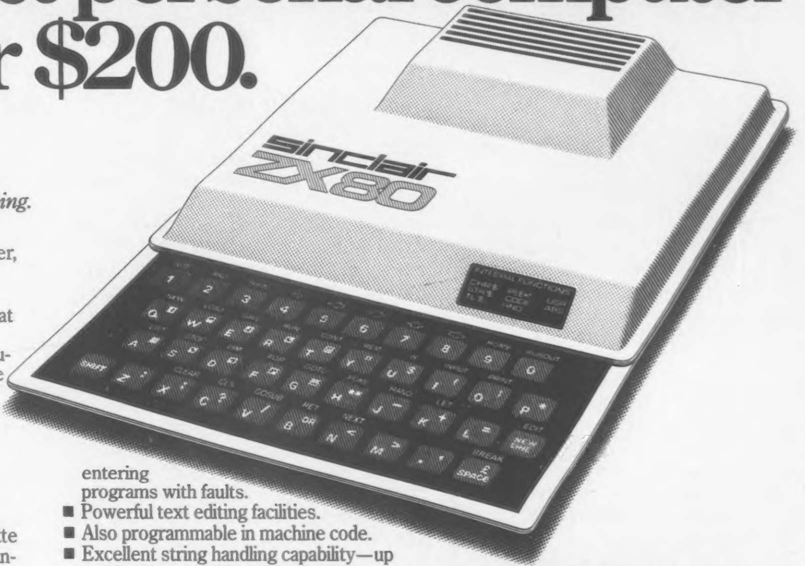

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Creative Computing
SOFTWARE PROFILE

EasyWriter

David H. Ahl

As I sit here in a seedy hotel room in San Francisco, I'm struck by the schism between those who take high technology, such as computers, for granted, and the rest of the world. Let me explain. Yesterday on a visit to Information Unlimited Software in Berkeley, Larry Weiss gave me a copy of EasyWriter for evaluation. Since I had an Apple with me, I decided to rev up the system tonight in my hotel room. My choice of an economical $25 room in the Hotel Victoria near Chinatown did not make this task an easy one.

First of all, my room had no TV set. The desk clerk spoke very little English and had difficulty understanding why I wanted a TV in my room when I could watch the color set in the lobby. Finally, after checking five rooms, a set was located which I wheeled to my room. Second problem: the room did not have a grounded outlet and I did not wish to break the grounding prong off the Apple power cord. Solution: disassemble the fluorescent light in the bathroom and jury rig the wiring to the Apple power cord. Problem 3: an antenna cable was permanently wired to the TV set (to discourage theft?) and terminated into an extremely strange connector. Problem 4: the TV did not have UHF and the Sup-R-Mod in the Apple was putting out a signal to channel 33. Solution to 3 and 4: twist the Apple cable and the TV cable together for about a 5-foot length, tune to channel 10 and a passable signal appeared. (Barely passable).

With EasyWriter, characters did not get lost even at high typing speeds.

Light a cigar, pour some wine, and plunge in. Here's what I found.

EasyWriter is obviously modeled after Electric Pencil. Most of the cursor controls are the same (a,w,s,z--left, up, right and down), scrolling, insert, delete and tabs are virtually identical. Control/p exits to the print system, control/k to the disk system and control/o to Basic.

There are some notable differences between EasyWriter and Electric Pencil. For example, line feed becomes shift/m on the Apple. Two line feeds are required before the entry of text and between paragraphs. Control/t is an 8-character tab; however, it seems to disappear when scrolling backwards or forward through the text. Since the Apple II has only an upper–case display, upper- and lower–case letters are defined by hitting "ESC" to make the following characters upper case. To cancel upper case, "ESC" is hit twice. Since the Apple I was using had a lower case chip in it, this did not seem to work. However, I'm sure there is a way to make it behave. I just haven't found it yet.

EasyWriter has a feature that detects the end of screen so that words are not split when they do not fit on the screen. This is called "Screen Wrap-Around." On Electric Pencil, this feature usually drops one or two characters, whereas with EasyWriter, characters did not get lost even at high typing speeds.

A little glitch: EasyWriter automatically leaves two spaces after a period which is what one usually wants. However, if a period is enclosed in quotation marks as in the above paragraph, two spaces are not wanted. To eliminate the space requires a user-defined character, a somewhat awkward thing to remember.

Moving blocks requires a sequence of eight commands, a bit unhandy. If one does much moving, it is probably something which can be memorized. However, compared to the simpler block move routine of Electric Pencil, it seems cumbersome. A further glitch is that blocks must be moved starting with the right side of a line. Thus, one cannot move a sentence from the middle of a paragraph. On the other hand, after years of using a word processing system for many, many articles, I can't recall moving blocks more than about 10 or 12 times.

The scrolling commands are excellent. Screenfuls of text can be scrolled up, down and the last line on the top or bottom is retained to help keep one's place. This is a nice feature.

The word searching procedure allows you to search for one specific word or for groups of words using the "wild card" feature. For example T### would find any four letter word beginning with t.

Print commands can be imbedded in the text so margins can be set, skip lines, set indents, justification, line lengths, page lengths and so on throughout the text.

Text files can, of course, be saved, retrieved, revised and deleted. When you are about to do a dangerous or irreversible operation, a warning beep sounds in the speaker, a nice touch. Files may be protected or not as you wish. The disk system also permits you to format new disks, another thoughtful touch.

Blocks must be moved starting with the right side of a line. Thus, one cannot move a sentence from the middle of a paragraph.

The print subsystem permits you to specify page length, spacing between pages, line spacing and length, indent, justification and form feed (stop after each page or continuous print). Titles, headers, and page numbers can also be specified.

The print subsystem provides support for most common printers including proportional spacing units such as the Qume and Diablo.

Not-so-handy features of the print subsystem include boldface, superscripts and subscripts, and tabular formats. All of them are possible but require somewhat unusual successions of special characters.

The manual is quite complete and explains the commands and features in detail. In most cases, it gives examples as well as the description of the command.

EasyWriter was written by John Draper, who deserves a great deal of credit for this highly useful and user-oriented piece of software for the Apple II. It is available for $99.95 from many computer stores or Information Unlimited Software, 793 Vincente Ave., Berkeley, CA 94707 ☐

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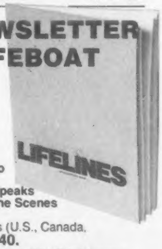

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† Recommended system configuration consists of 48K CP/M, 2 full size disk drives, 24 x 80 CRT and 132 column printer.

Ⓜ Modified version available for use with CP/M as implemented on Heath and TRS-80 Model I computers.

Ⓛ User license agreement for this product must be signed and returned to Lifeboat Associates before shipment may be made.

Ⓘ Ⓧ This product Includes/eXcludes the language manual recommended in Condiments.

Ⓢ Serial number of CP/M system must be supplied with orders.

Ⓩ Requires Z80 CPU.

Ordering Information

MEDIA FORMAT ORDERING CODES
When ordering, please specify format code.

LIFEBOAT ASSOCIATES MEDIA FORMATS LIST
Diskette, cartridge disk and cartridge tape format codes to be specified when ordering software for listed computer or disk systems. All software products have specific requirements in terms of hardware or software support, such as MPU type, memory size, support operating system or language.

Computer system	Format Code
Altair 8800 Disk	See MITS 3200
Altos	A1*
Apple + SoftCard 13 Sector	RG
Apple + SoftCard 16 Sector	RR
BASF System 7100	RD
Blackhawk Single Density	Q3
Blackhawk Micropolis Mod II	Q2
CDS Versatile 3B	Q1
CDS Versatile 4	Q2
COMPAL-80	Q2
Cromemco System 3	A1*
Cromemco Z2D	R6
CSSN BACKUP (tape)	T1 #
Delta	A1*
Digi-Log Microterm II	RD
Digital Microsystems	A1*
Discus	See Morrow Discus
Durango F-85	RL
Dynabyte DB8/2	R1
Dynabyte DB8/4	A1*
Exidy Sorcerer + Lifeboat CP/M	Q2
Exidy Sorcerer + Exidy CP/M	Q4
Heath H8 + H17/H27	P4
Heath H89 + Lifeboat CP/M	P4
Heath H89 + Magnolia CP/M	P7
Helios II	See Processor Technology
Horizon	See North Star
iCOM 2411 Micro Floppy	R3
iCOM 3712	A1
iCOM 3812	A1*
iCOM 4511 5440 Cartridge CP/M 1.4	D1 #
iCOM 4511 5440 Cartridge CP/M 2.2	D2 #
IMS 5000	RA
IMS 8000	A1*
IMSAI VDP-40	R4**
IMSAI VDP-42	R4**
IMSAI VDP-44	R5**
IMSAI VDP-80	A1**
Intecolor	See ISC Intecolor
Intel MDS Single Density	A1
Intertec SuperBrain DOS 0.1	R7
Intertec SuperBrain DOS 0.5-2.X	RJ
Intertec SuperBrain DOS 3.X	RK
ISC Intecolor 8063/8360/8963	A1
Kontron PSI-80	RF
Meca 5¼"	P6
Micromation (Except TRS-80 below)	A1*
Micropolis Mod I	Q1
Micropolis Mod II	Q2
MITS 3200/3202	B1
Morrow Discus	A1*
Mostek	A1
MSD 5¼"	RC
North Star Single Density	P1
North Star Double/Quad	P2
Nylac Single Density	Q3
Nylac Micropolis Mod. II	Q2
Ohio Scientific C3	A3
Onyx C8001	T2 #
Pertec PCC 2000	A1*
Processor Technology Helios II	B2
Quay 500	RO
Quay 520	RP
RAIR Single Density	R9
RAIR Double Density	RE
Research Machines 8"	A1
Research Machines 5¼"	RH
REX	Q3
Sanco 7000 5¼"	RQ
SD Systems 8"	A1*
SD Systems 5¼"	R3
Sorcerer	See Exidy Sorcerer
Spacebyte	A1
SuperBrain	See Intertec
Tarbell	A1*
TEI 5¼"	R3
TEI 8"	A1*
Thinkertoys	See Morrow Discus
TRS-80 Model I 5¼"	R2
TRS-80 Model I + FEC Freedom	RN
TRS-80 Model I + Micromation	A4*
TRS-80 Model I + Omikron 5¼"	RM
TRS-80 Model I + Omikron 8"	A1
TRS-80 Model I + Shuffleboard 8"	A1
TRS-80 Model II	A1*
VDP-40/42/44/80	See IMSAI
Vector MZ	Q2
Versatile	See CDS Versatile
Vista V80 5¼" Single Density	P5
Vista V200 5¼" Double Density	P6
Zenith Z89 + Lifeboat CP/M	P4
Zenith Z89 + Magnolia CP/M	P7

Prices F.O.B. New York. Shipping, handling and C.O.D. charges extra.

Manual cost applicable against price of subsequent software purchase.

The sale of each proprietary software package conveys a license for use on one system only.

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* Single-Side Single-Density disks are supplied for use with Double-Density and Double-Side 8" soft sector format systems.

** IMSAI formats are single density with directory offset of zero.

# A media surcharge of $25 for orders on tape formats T1 and T2 and of $100 for orders on disk formats D1 and D2 will be added.

The list of available formats is subject to change without notice. In case of uncertainty, call to confirm the format code for any particular equipment.

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creative computing
EQUIPMENT PROFILE

Radio Shack Voxbox

David A. Hinton

Radio Shack has begun marketing a voice input device for the TRS-80. The Voxbox gives the Model I Level II owner an opportunity to experiment with computerized speech recognition.

The Voxbox Hardware

The Voxbox is housed in a strong gray plastic case measuring 7¾"W x 1¾"H x ¼"D. It has a rear attached 10-inch ribbon cable and a DIN jack located in front for connecting a standard Radio Shack dynamic push-to-talk CB microphone which is included. Also included in the $169.95 purchase price is an informative owner's manual and three cassette tapes containing the necessary driver software and three demonstration programs.

Plugging It In

The Voxbox requires no special interfacing; it may be connected directly to the TRS-80 bus by attaching its ribbon cable to the card edge connector at the rear of the keyboard unit, or to the expansion board connector on the expansion interface. After the microphone is attached to the DIN jack and the power supply mini-plug is inserted into the jack at the rear, the power supply is plugged into a 120 VAC wall outlet. The Voxbox hardware is now ready to use.

I discovered a hidden feature of the Voxbox hardware. At the rear of the Voxbox case is a small cover. I unsnapped the cover at the bottom edge of the case and found a concealed card-edge connector. Upon further examination, I discovered it was an extension of the TRS-80 bus. Its pin configuration is identical to the card-edge connector at the rear of the keyboard unit and the expansion-board connector on the expansion interface. This allows a user to operate the Voxbox and still have a bus connection available for another bus-supported peripheral such as the Voice Synthesizer or Quick Printer II. There is absolutely no mention of this feature anywhere in the Voxbox owner's manual.

Software Support

A full 4K of high memory must be protected to provide room for the driver software and buffer storage for the 32-word user-defined vocabulary. You must, therefore, have at least a 16K system in order to use this peripheral.

Three machine-language driver programs are provided on cassette. You choose a driver based on whether you have 16K, 32K or 48K of RAM in your system. The owner's manual gives all the information necessary to load and initialize these drivers, and information is provided for saving them on disk.

The three Basic-language application programs supplied are intended to give you some immediate hands-on experience and familiarize you with the techniques involved with using the Voxbox. The Inventory Demonstrator allows you to input part numbers and quantities of an imaginary inventory and demonstrates the use of a "keyword" or "wake-up word" to start a command or data sequence.

Lunar Lander is the standard lunar lander game, except that the burn rates and "fire" directives are given by voice command. This is a good demonstration of how the Voxbox can be used in a game environment.

The third application program, Voice Plotter, displays a graphic representation of any sound you make into the microphone. It displays the raw data used by the computer to recognize words. The TRS-80 graphics capabilities are used to create four plots on the video display. The uppermost plot indicates energy present in the 900 to 2200 Hz range. The next plot indicates energy in the 100 to 900 Hz range. The third plot illustrates the dominant frequency in the 900 to 5000 Hz range. And the bottom plot is an estimate of the dominant frequency in the 200 to 900 Hz range. All these values are measured at 10 millisecond intervals.

Source listings for the application programs are given in the manual but no listings are provided for the drivers.

Putting It to Use

The driver program has three routines you can call from Basic. These routines, called by the USR function, are labelled "initialization, training and recognition," according to the owner's manual. Initialization clears the speech files at the beginning of your application program by resetting the sample table to all zeros. Any previously stored speech data is lost.

Next, you must call the training routine. It is called once for each word to be sampled and stored. You must pass, to the training routine, an index number from 0 through 31 which tells the computer in which of the 32 slots in the table this

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Voxbox, cont'd...

sample is to be stored. The audio input can be up to 1.5 seconds long; silence of .1 second or more is assumed, by the system, to be the end of the sample.

The third routine, word recognition, is called anytime you want the Voxbox to listen to an audio input and match it with the samples in the sample table. If the input is recognized (i.e., if a match is found), the computer will return the index number of the corresponding slot in the table. If an input is not recognized, due to a failure in finding a match (or the audio input being longer than 1.5 seconds), the computer returns a value of 32. A returned value of 32, instead of an index value of from 0 through 31, is the computer's Reject code. It is up to the user to provide an application for the returned code numbers.

Observations

I was most interested in learning if the Voxbox was reliable enough to use in practical applications. I was understandably alarmed as I began reading page one of the owner's manual and found the following note. “ . . . Radio Shack recommends that the unit be used primarily for entertainment and experimentation. Proceed advisedly before committing the unit to any serious application.”

Then, after reading on, my attitude improved as I learned how the device worked and how to put it through its paces. It had reached page 19 before I was shaken by another reference to its performance. “As is true with human listeners, your Voxbox will sometimes make mistakes when listening to you.” The manual did claim, however, that the Voxbox had a 85-95% recognition providing “ . . . you take reasonable care in speaking clearly and distinctly.”

The manual did claim, however, that the Voxbox had a 85-95% recognition providing “ . . . you take reasonable care in speaking clearly and distinctly.”

I tried the first two application programs described earlier and found I got only a 50-75% recognition. I then made a tape recording of my voice speaking the command words and used this record to “train” the Voxbox. By using the recording of my voice to control the program, I obtained the level of recognition mentioned in the manual.

With more experimentation, I determined part of my problem was due to the microphone's ability to pick up background sound in the room. The Voxbox processed the background along with my voice. If I later spoke the same word or words, without the same background sound, the Voxbox would often fail to find a proper match in the sample table. It seems the unit's performance could be greatly improved by using some type of noise-cancelling microphone.

Appendix A of the manual provides information on modifying a “rejection parameter” value stored in the driver program. Increasing the value causes fewer words to be rejected. Unfortunately, this also increases the chance for more mistakes of the other kind — wrongly identifying the word being identified. Decreasing the value causes more words to be rejected and makes it more difficult to find a match. I found the preset value of the rejection parameter to be the most acceptable compromise.

In Conclusion

I found that the Voxbox performs reasonably well if it is used in a quiet room and care is taken to pronounce words clearly, distinctly and consistently. I feel the technology used in this unit is acceptable for “entertainment or experimentation” but not predictable enough for serious application, such as a voice input device for a computer used to control systems and equipment in a house or business. ☐

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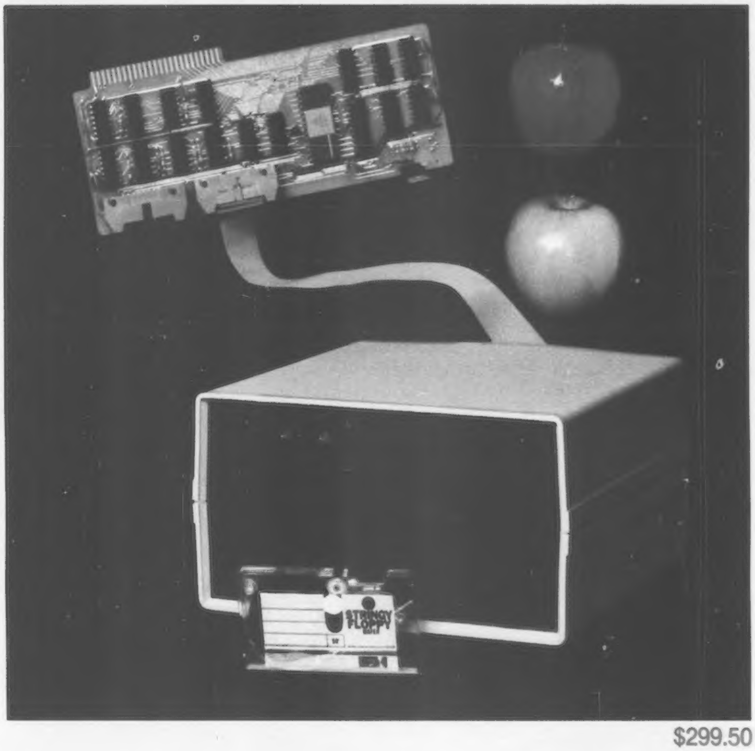

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Ecology Simulations - 2

creative computing
SOFTWARE PROFILE

Bug Off

David Lubar

A Perilous Assignment

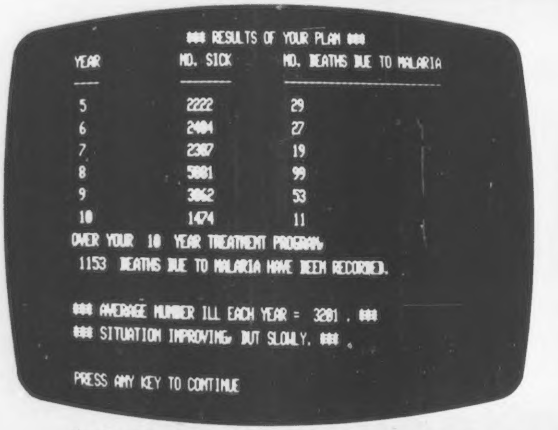
With quinine water in hand and pith helmet on head, I took stock of the grim situation. One hundred thousand folk lived in daily fear of tremors and fever, lived in dread that they would succumb to that vicious scourge of the jungle. Each year one fourth of the population fell sick, and over one thousand of them died. I was their hope. I had been assigned to rid them of *Malaria.* Armed with medicine, sprays, and a five-year plan, it was me against the anopheles. On my first day in the jungle, I found there were many choices to be made. Field hospitals could be set up, but at a cost of $2000 each. With only twenty beds to a hospital, this would quickly eat into my budget, taking a large chunk from the $500,000 available. Drugs could be purchased to treat the sick. These cost a mere $2.00 per dose. Still, many doses would be needed. These measures were curative. My long-range goals required preventative measures. I could spray insecticide. DDT was available at a bargain price, but it did a hatchet job on the environment. Malathion and Propoxur were less harmful to the ecology, but they cost a bundle. Anti-malarial drugs could be had for only 72 cents a dose. This seemed the way to go.

I was ready. Throwing up a few field hospitals and treating some of the sick, I saved most of my funds for DDT and inoculations. I soaked the jungle with spray and pumped everyone's veins full of preventative drugs. Success seemed assured. Perhaps I could retire at an early age and write my memoirs.

The five years seemed to pass in seconds. I summoned my trusty aid, Teeyar Esaydee, and sent him for the statistics. The first year showed little evidence of change, but I was not disturbed; mine was a long-range plan. The second year was a bit worse. These things take time. To my surprise, the rate of death and disease continued to climb. Outside the hut, angry natives gathered. A suggestion came down from above, hinting that I should look for other work. Undaunted, I refused to quit. I stayed and tried new measures, searching for that balance which would end this pestilence. In time, the death rate began to drop. There was still too much disease, but I was confident that, given time, I would triumph.

Back to the Real World

This, bwana, is Huntington's *Malaria* simulation, one of four programs on *Ecology Simulations - 2,* available on disk or tape for the TRS-80. The above description just brushes the surface. There is more. At the start, you have the choice of working within a budget or spending unlimited funds. As each option is presented, you have a choice of whether or not to use that measure. If you elect to skip one, the program moves on to the next. For each one you select, you decide how to distribute it over the five-year period. After each choice, the remaining budget is displayed. If purchases exceed the budget, the section is repeated. After deciding on what measures to use over a five-year period, the amount of disease and death for each year is displayed. A graph is available that shows the effectiveness of each measure along with comments and analysis. At the end of a period, the player can start a new round or continue at the point where he left off. If the simulation continues, surplus drugs and funds can be applied to the next period.

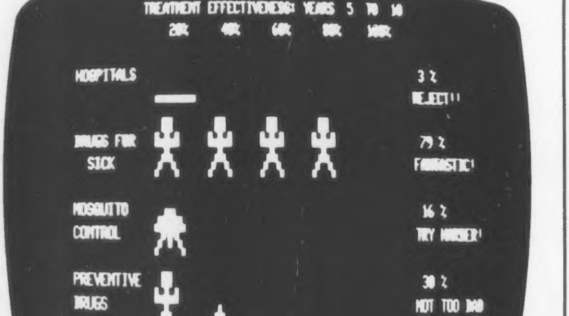


```
              ### RESULTS OF YOUR PLAN ###
YEAR          NO. SICK        NO. DEATHS DUE TO MALARIA
----          --------        -------------------------
 5             2222            29
 6             2404            27
 7             2307            19
 8             5081            99
 9             3062            53
 10            1474            11
OVER YOUR  10  YEAR TREATMENT PROGRAM,
 1153  DEATHS DUE TO MALARIA HAVE BEEN RECORDED.

### AVERAGE NUMBER ILL EACH YEAR =  3201 . ###
### SITUATION IMPROVING, BUT SLOWLY. ###

PRESS ANY KEY TO CONTINUE
```

Results of the second five-year period. My plan needs work.



```
          TREATMENT EFFECTIVENESS: YEARS 5 TO 10
             20%    40%    60%    80%    100%

HOSPITALS                                        3 %
                                                 REJECT!!

DRUGS FOR                                        79 %
  SICK                                           FANTASTIC!

MOSQUITO                                         16 %
CONTROL                                          TRY HARDER!

PREVENTIVE                                       30 %
DRUGS                                            NOT TOO BAD

PRESS ANY KEY TO CONTINUE
```

My failings are made painfully clear by this graph.

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Actual Photograph of WordPro on CBM Model 8032

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Bug, cont'd. . .

Anatomy of a Disease

Most of us know of malaria from late-night movies where the hero suddenly breaks into sweaty fits of trembling, blaming his attack on something he picked up in the tropics. To those living in infested areas, the disease is much more real and threatening. One infected person can pass the disease to 800 mosquitoes. These mosquitoes, in turn, could infect an additional 1100 to 1200 people. Obviously, this is not the sort of disease that can be easily eliminated, especially considering the unfortunate state of health care in the areas where malaria is most common. Taking the role of a health official under these circumstances is a challenging and educational experience. Malaria can't be beaten, but it can be controlled.

Getting Started

There are several ways to approach *Malaria*. A player can try working without a budget at first. This is one way to quickly determine the most effective use of each measure. Another way would be to try using just one measure for an entire period to determine how well it works in isolation. If this approach is used, the player should remember that the results could change greatly when other measures are added. Perhaps the most interesting approach is to work within a budget from the start, simulating the work of a health official who is coping with an epidemic. It is rather enlightening to discover how well or poorly your expectations are fulfilled by various plans of treatment.

At any point, the player can get help by entering –1. This comes in handy if you forget the cost of one of the measures. *Malaria* is complex and well structured. It isn't just a random bug hunt; each choice affects the final results, each decision becomes part of a total strategy. A balance has to be found that limits the disease and lowers the death rate. By experimenting with different measures, you can slowly find the right types of combinations needed to keep down the spread of malaria.

Summing it up

The amount of research and planning that went into *Malaria* is impressive. Each parameter seems to have been carefully thought out. For example, it is impossible to eliminate the entire mosquito population since some of them will have a natural immunity to any spray, and there is immigration from surrounding areas. The field hospitals have to be replaced yearly since they can't survive a full season of jungle weather. (Let's face it, nothing that cost only $2000 to build is going to last very long.) The program also makes a number of assumptions about the human population. Some of them will have developed a resistance to malaria. The birthrate is high enough to keep the population steady despite the spread of the disease. The length of hospital confinement is substantially shortened when drugs are available.

There is more that could be said, but a new shipment of DDT just came in and the field hospitals need repair, and it seems to be getting a bit hot in here. Perhaps I've got a slight touch of fever.

Ecology Simulations - 2 is available for $24.95 for the TRS-80 (specify disk or tape) from *Creative Computing Software,* P.O. Box 789-M, Morristown, NJ 07960. Apple and Atari versions will be available in December ($24.95 each, disk only). ☐

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Economic and Ecology Simulations

The Ecology Simulations series are a unique educational tool. They are based on "simulation models" developed by the Huntington Two Computer Project at the State University of New York at Stony Brook under the direction of Dr. Ludwig Braun. The programs and accompanying documentation are written for self-teaching or classroom use and include background material, sample exercises and study guides. Graphic displays were specially developed by Jo Ann Comito at SUNY and Ann Corrigan at Creative Computing. The Ecology Simulations packages are a remarkable educational application of micro-computers.

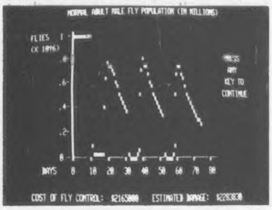
Ecology Simulations-1, CS-3201 (16K)

1. Pop

The POP series of models examines three different methods of population projection, including exponential, S-shaped or logistical, and logistical with low density effects. At the same time the programs introduce the concept of successive refinement of a model, since each POP model adds more details than the previous one.

2. Sterl

STERL allows you to investigate the effectiveness of two different methods of pest control—the use of pesticides and the release of sterile males into the fly population. The concept of a more environmentally sound approach versus traditional chemical methods is introduced. In addition, STERL demonstrates the effectiveness of an integrated approach over either alternative by itself.


NORMAL ADULT MALE FLY POPULATION (IN MILLIONS)
FLIES
(X 10↑6)
1
.8
.6
.4
.2
0
PRESS
ANY
KEY TO
CONTINUE
DAYS 0 10 20 30 40 50 60 70 80
COST OF FLY CONTROL: $2165000 ESTIMATED DAMAGE: $2283830

3. Tag

TAG simulates the tagging and recovery method that is used by scientists to estimate animal populations. You attempt to estimate the bass population in a warm-water, bass-bluegill farm pond. Tagged fish are released in the pond and samples are recovered at timed intervals. By presenting a detailed simulation of real sampling by "tagging and recovery," TAG helps you to understand this process.

4. Buffalo

BUFFALO simulates the yearly cycle of buffalo population growth and decline, and allows you to investigate the effects of different herd management policies. Simulations such as BUFFALO allow you to explore "What if" questions and experiment with approaches that might be disastrous in real life.

Ordering Information

The series is designed for the 16K TRS-80 Level II and is attractively packaged in a vinyl binder with a complete study guide. *Ecology Simulations-I:* disk CS-3501, cassette 3201. *Ecology Simulations-II:* disk CS-3502, cassette CS-3204. *Social and Economic Simulations:* disk CS-3508, cassette CS-3204. At a modest $24.95 each, the series is an affordable necessity.

To order, send payment plus $1.00 shipping and handling to Creative Computing Software, Dept. ACGG, P.O. Box 789-M, Morristown, NJ 07960. For Faster Service, call in your order toll-free to our order hotline 800-631-8112. In NJ call 201-540-0445.

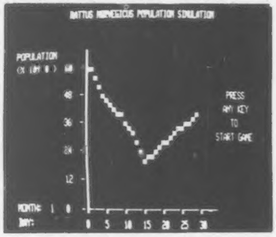
Ecology Simulations-2, CS-3202 (16K)

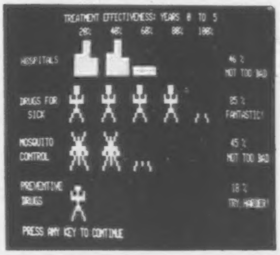
1. Pollute

POLLUTE focuses on one part of the water pollution problem; the accumulation of certain waste materials in waterways and their effect on dissolved oxygen levels in the water. You can use the computer to investigate the effects of different variables such as the body of water, temperature, and the rate of dumping waste material. Various types of primary and secondary waste treatment, as well as the impact of scientific and economic decisions can be examined.

2. Rats

In RATS, you play the role of a Health Department official devising an effective, practical plant to control rats. The plan may combine the use of sanitation and slow kill and quick kill poisons to eliminate a rat population. It is also possible to change the initial population size, growth rate, and whether the simulation will take place in an apartment building or an entire city.





3. Malaria

With MALARIA, you are a Health Official trying to control a malaria epidemic while taking into account financial considerations in setting up a program. The budgeted use of field hospitals, drugs for the ill, three types of pesticides, and preventative medication, must be properly combined for an effective control program.

4. Diet

DIET is designed to explore the effect of four basic substances, protein, lipids, calories and carbohydrates, on your diet. You enter a list of the types and amounts of food eaten in a typical day, as well as your age, weight, sex, health and a physical activity factor. DIET is particularly valuable in indicating how a diet can be changed to raise or lower body weights and provide proper nutrition.

Social and Economic Simulations CS-3204 (16K)

1. Limits

LIMITS is a micro-computer version of the well known "Limits to Growth" project done at MIT. It contains a model of the world that is built of five subsystems (population, pollution, food supply, industrial output, and resource usage) linked together by six variables: birth rate, death rate, pollution generation, resource usage rate, industrial output growth rate, and food production rate.

2. Market

Market allows two or more people to play the roles of companies who are competing for the market for a particular product: in this case, bicycles.

Each player makes marketing decisions quarterly including the production level, the advertising budget, and the unit price of the product for his/her company.

3. USPop

USPOP allows the user to study many aspects of the United States' human demography (population change) including population growth, age and sex distribution. USPOP makes population projections and investigates the consequences of many different demographic changes.

Basex:
Faster Code for your TRS-80

Ray C. Horn, Jr.

You can sell any computer language to hobbyists, as long as you call it Basic. Here's an example.

Simulation programming is one of the more exciting fields of endeavor, especially when you are able to run your program in machine language.

But what if you've just spent the last week and a half working the bugs out of the Basic coding and it's finally up and running, and it's slow? The most obvious weakness of interpretive Basic is its slow speed in the execution department. Simulation programming demands speed, the type of speed that machine language delivers. The only problem with machine language is that it usually takes a little longer to produce quality software.

Well, for all those hackers out there who have invested all that time and energy in Basic, but want more speed than an interpreter can deliver, I've got the answer: Basex!

A wonderfully simplistic high-level compiler written by Paul Warme, Basex stands for BASic and EXecutable machine code. It is capable of delivering machine code that can execute anywhere from twice to twenty-five times faster than an interpretive Basic, such as Level II on the TRS-80.

Basex structuring is somewhat similar to Basic, but if you don't read through the manual carefully you're going to get into trouble. The first two or three programs I wrote in Basex, converted from Basic listings, weren't exactly successful, just because I only skimmed through the manual and didn't pay real close attention to my syntax and structuring.

For instance, to convert something like: LET BYTE = PEEK(ADDRESS) from Basic to Basex, you write this: BRD ADDRESS and SET BYTE = A on two consecutive lines. The reason for the second line is because just about everything in Basex goes through the 16-bit accumulator called 'A'. Most programmers that like Basic are hooked because of the freedom and elegance in which you can code a statement like:

LET X = (((3*R)-(2*Y))/(6*Q))

all on one single command line.

Basex isn't that elegant. But you can accomplish the same end result; it just takes a few more lines and a little extra time to think the thing through. The Basex equivalent would look like:

MLT 3*R, SET R3=A, MLT 2*Y,
SET Y2=A, MLT 6*Q, SET Q6=A,
SBT R3-Y2, DIV A/Q6, SET X=A

a grand total of nine lines.

Basex's strength does not lie in its elegant structuring but where it's really needed, in its method of compilation and its speed of execution.

Basex is advertised as being an interactive compiler, and that's exactly what it is. The machine code is compiled as you enter the source code. In fact, after you've entered the program you not only have access to the source code, but you've also got access to the machine code. Any time you need a listing of the source code you simply type

LST LOW-ADDRESS
HIGH-ADDRESS

and press Enter, and you'll get the source code output to the video terminal. By pressing the space bar you can momentarily halt the scrolling; releasing the space bar will cause the scrolling to continue. If you need a hexadecimal dump of the machine code you simply type

After you've entered the program you not only have access to the source code, but you've also got access to the machine code.

DMP LOW-ADDRESS
HIGH-ADDRESS

and press Enter; using the same addresses as the LIST will produce a hex dump of the machine code program produced by the compilation of the source code.

Sounds easy, doesn't it? It's certainly easier than trying to program the same function in machine language straight out.

With Basex you get the same type of ease and flexibility we've all grown to know and expect from interpretive Basic, as well as greatly improved speed of execution.

To emphasize my point I am including a Basex source listing for the famed Vibrating String program, found in the June '80 issue of *Creative Computing*. This version of the program was converted directly from the first Basic listing found in that article.

I finished the initial rough draft in just a few hours, and it ran on the first attempt at compilation. The final product took only 825 bytes (not including the execution routines).

The Basex Loader has a very useful utility routine known as FIX, through which you may relocate both the source code and the symbol table and then compress the relocated code by almost 25%. In this case the FIXed Vibrating String program uses only about 692 bytes. Add this to the execution routines and the entire package needs only 3070 bytes as a stand-alone program.

For those of you who don't have access to a Basex compiler this should give you the incentive to go out and pick one up. Basex is available through Interactive Microware Inc. in the form of a BYTE book and the necessary patches for TRS-80 owners. Basex will run on a CP/M system with no modifications.

All things considered, Basex is a very powerful and very easy high-level language compiler to both use and share with others. If you are interested in producing fast-running machine code without having to wade through an assembler, then this compiler is for you. ☐

Vibrating String
Basex listing:

```
? DIM KEY$ 1
? *** LINE30
? FCN 2
? SET XARRAY=40000
? SET YARRAY=50000
? FOR I=0
? ADD XARRAY+I
? SET VALUE=A
? BRT VALUE=63
? ADD YARRAY+I
? BRT A=0
? BRD VALUE
? SET X=A
? PLT 1 X I
? TIL I 1 47
? *** LINE60
? FCN 1
? STR KEY$ 1 1 A
? CMP KEY$ 1 1 ""
? JMP EQ LINE140
? BRD XARRAY
? PLT -1 A 0
? CMP KEY$ 1 1 "X"
? JMP EQ LINE30
? CMP KEY$ 1 1 "R"
? JMP NE CONT1
? BRT XARRAY=83
? *** CONT1
? CMP KEY$ 1 1 "L"
? JMP NE CONT2
? BRT XARRAY=43
? *** CONT2
? CMP KEY$ 1 1 "M"
? JMP NE CONT3
? BRT XARRAY=63
? *** CONT3
? BRD XARRAY
? PLT 1 A 0
? *** LINE140
? FOR I=1
? SBT I-1
? ADD XARRAY+A
? BRD A
? SET AC=A
? ADD I+1
? ADD XARRAY+A
? BRD A
? ADD AC+A
? SET AC=A
? ADD XARRAY+I
? BRD A
? MLT 2*A
? SBT AC-A
? SET AC=A
? DIV AC/2
? SET AC1=A
? ADD YARRAY+I
? SET V2=A
? BRD A
? ADD AC1+A
? BRT V2=A
? TIL I 1 46
? *** LINE170
? FOR I=1
? ADD XARRAY+I
? BRD A
? PLT -1 A I
? ADD YARRAY+I
? BRD A
? SET V2=A
? ADD XARRAY+I
? SET V4=A
? BRD A
? SET V3=A
? ADD V2+V3
? BRT V4=A
? ADD XARRAY+I
? BRD A
? PLT 1 A I
? TIL I 1 46
? GTO LINE60
```

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creative computing
SOFTWARE PROFILE

The Musicraft Development System

Glenn Hart

Music systems for personal computers have come far in the last few years. At the music-generating end of the system, the world seems to be coming around to the Hal Chamberlin point-of-view that the synthesis should be done by the host processor, and not necessarily by very elaborate dedicated hardware. (At least, this is my personal interpretation of Hal Chamberlin's own personal interpretation.) This design philosophy is represented by music systems like the Newtech board (and many others) which consist of an unadorned DAC (digital to analog converter) hung off the main cpu. The processor computes the entire signal and then presents it in digital form to the hardware interface. The opposite approach is to design very elaborate special-purpose hardware, like Solid State Music's S-100 digitally controlled digital synthesizer, which has lots of no-board buffers for waveforms and envelopes and control parameters, fed at a very leisurely pace by the host cpu. This approach is too expensive to succeed, and it seems preferable to put as much flexibility as possible into the hardware, and let final decisions and hard thinking be done in software, where it belongs.

At the user-interface level, we are discovering that it is not much fun to learn a complex high-level music encoding language to enter music into a computer, nor is there any good reason to do so. In fact, a very well thought out, easy to understand, user-oriented music encoding system has already existed for hundreds of years, and putting it up on a computer is no big deal. For commercial systems, the problem is mainly in standardization of the graphics interface, and this is no problem at all if you have an Apple. For other systems with less advanced graphics, one must get along with the numbering and lettering encoding system described in this review.

The application of this very natural language for music programming (that is, written sheet music) gives rise to other thoughts about computer languages is general. Certainly, the most popular languages to date have been those which focus attention on the computer—the machinery by which work is done—rather than on the actual problem or its solution. Perhaps we could have better computer languages if they could focus on problem-solving and leave the internals of the process (playing the instrument) hidden from the user. —SN

Glenn A. Hart, 51 Church Road, Monsey, NY 10952.

Sound can be produced by converting a sequence of binary numbers into an analog waveform by passing the binary information through a circuit known as a digital-to-analog converter (DAC). Changing the values of the binary data can, at least theoretically, result in the creation of any desired sound wave.

While any DAC can be used for this function, several devices specifically designed for music production are available for S-100 and other computers. One of the earliest and least expensive is the Newtech Model 6 music board available for 8080/8085/Z-80 and 6800 systems and also in a TRS-80 version sold by Newtech Computer Systems, 230 Clinton Street, Brooklyn, New York 11201.

Music systems designed for S-100 computers have traditionally suffered from one major weakness. In the absence of the graphics and direct analog input devices available on some integrated computer systems, the only method of entering musical information has been through some sort of special language or code using the ASCII character set. This is far more cumbersome than entering music by indicating note positions and durations on a musical staff.

Musicraft, a software package from Computercraft, 1031 Marlau drive, Baltimore, Maryland 21212, updates this time-honored entry method, makes it far more pleasant and useable and adds many interesting new features in the process.

Musicraft can be used with any DAC board, although it is a natural match for the Newtech Model 6. It requires an 8080, 8085 or Z-80 system with either 24K of RAM if CP/M is used or 32K if operating under the North Star DOS. Floppy disks are intrinsic to the program design, and a CRT terminal with absolute cursor addressing is mandatory (a memory-mapped video board will also work as long as it has cursor addressing).

The program is adapted to any such system with a utility called SETUP. Various common terminals can be accommodated with a single keystroke; the necessary information for terminals not listed is easily entered once the slightly confusing instructions are understood. Provisions are made for the different processors with which the system can be used and special modules are easily incorporated which cover a wide range of clock speeds. The program worked perfectly on both my 4 MHz Z-80 and 3 MHz 8085 computers.

The system consists of several programs, each serving a specific function in the music generation process. Programs are available to enter and modify song text, compile the song file into a binary form, create waveform files, play a compiled song and print the ASCII song file on a hard copy printer.

EDIT

The main program is EDIT, which is a screen-oriented entry and correction editor. EDIT is extremely powerful, yet easy to use, and makes the entry of ASCII music code rather simple.

EDIT allows the entry of up to *four* separate and distinct musical voices. Each musical event is given a duration letter from a very precise list of options (see Table I) and either a period or a colon can follow the duration letter to indicate a dotted or double-dotted note respectively for even finer gradations. Each note which occurs at this time requires three characters: a letter indicating pitch (A-G), an accidental symbol (# for sharp, @ for natural or ! for flat) and an octave number between 1 and 7. Note that the symbols chosen for accidentals represent the upper case of the numbers 1, 2 and 3 on a typewriter keyboard; the numbers themselves can be entered and the program will recognize the operator's intent and convert them to accidental symbols, making entry quicker.

Musicraft also supports microtones, or pitches between the traditional twelve tones of the standard octave. An octave can be divided into any number of tones up to 99, and a number rather than the traditional pitches names A through G is then used to indicate the desired pitch. This feature can be used for eastern or modern music and can also provide very smooth glissandi (slides) in standard music.

The editor operates in four modes. An Insert mode is normally used for entering data for the first time and has various nice operating features to make entry easier and more convenient. The Edit mode is used to make corrections, an Excise mode removes data, and an Option mode allows incorporation of special information and performs various special functions described below. A one-line menu of functions available in the current mode (similar in approach to the UCSD Pascal system) appears at the top of the screen.

The basic layout of an editor screen is shown in Listing I. Music is maintained as a series of song lines, each containing a line number, the duration for the line and the pitches of each voice. The columnar design provides an easily readable layout of each voice. The terminal's normal cursor controls are used to move from place to place, with special keys like HOME used to move to the beginning or end of the song file. Other single keys allow insertion of measure lines, moving in either direction a measure at a time, etc. The system makes use of terminal functions like Erase to End of Line and Erase to End of Screen; if the user's terminal does not have these provisions the editor will simulate them in software at some sacrifice in speed.

The Options mode menu is shown in Table II. Musicraft employs the concept of subroutines to make repeats, alternate endings and other common musical structures easy.

When editing is complete, the editor is exited. An ASCII text file is created with the default extension .SNG. If the file already existed and this was an edit of that existing file, a backup of the original with type .SBK is created. These files can be examined with a text editor and/or typed out as is, and the manual explains the storage conventions used, but it is difficult and inadvisable to perform any manipulations on the files other than with Musicraft's editor.

COMPILE

The song file is then compiled with COMP. This is a two-pass compiler which converts the text data into binary form, incorporating tempo, waveform, repeat, chorus and other control parameters. The data file created by SETUP is referenced to make allowances for processor type and clock speed. A binary file of type .SCD is created.

Character	Meaning
Standard Notes	
W	Whole note
H	Half note
Q	Quarter note
E	Eighth note
S	Sixteenth note
T	Thirth-second note
X	Sixty-fourth note
Other Notes	
A	Triplet half note
B	1/5th of a whole note
C	Triplet quarter note
D	1/7th of a whole note
F	1/5th of a half note
G	Triplet eighth note
I	1/7th of a half note
J	1/5th of a quarter note
K	Triplet sixteenth note
L	1/7th of a quarter note
N	1/5th of an eighth note
P	Triplet thirty-second note
U	1/7th of an eighth note
V	1/5th of a sixteenth note
Y	triplet sixty-fourth note
Duration Adjustment	
. (period)	Same as dotting in musical notation
: (colon)	Same as double dotting in musical notation

Table I. Note Duration Options.

As the song file is being compiled, COMP prints various information on the screen, including control instructions, a period for each song line compiled and any appropriate error messages. If the verify option of the editor is used, errors should be rare, but any which do occur require re-entering the editor, making corrections and re-compiling, as with any compiler-type language.

WAVE

This utility allows creation of an unlimited number of waveform files. These short data files are used by the PLAY utility to determine the timbre of sound used to play each voice.

The basic approach used by WAVE is Fourier synthesis. In this technique, the amplitude of harmonics to the fundamental and the phase of the harmonics can be manipulated. The WAVE program allows entry of an unlimited number of harmonics in any strength and phase relationship (although more than seven or eight harmonics usually result in audible degradation due to the limited speed of the CPU and the resulting low sampling rate causing non-harmonic artifacts).

```
type a..
  C   to call a chorus (or refrain)
  F   to find a label, line or
      measure
  L   to label the current song
      line
  M   to set the number of
      intervals per octave
  R   to mark a repeat
  T   to change the tempo
  V   to verify completeness
  W   to change waveforms
  X   to end a chorus
  !   to change the flatted notes
  #   to change the sharped notes
...
```

Table II. Options Menu.

PLAY

This program loads the binary data files and actually performs the music by sending the data to the DAC board. It allows several songs to be entered at one time for sequential performance, but only if all the songs chosen have the same number of voices. Once the songs are chosen, the waveforms to be used are entered. As each waveform is named, the corresponding waveform data file is read and a graphic display of the shape of the wave is shown on the CRT screen. PLAY also allows interactive performance, with the operator entering labels for the program to skip to during actual performance.

At the conclusion of performance, the operator can repeat the song as just performed, enter different wave tables, enter an entirely different song and begin the process over again or exit to the operating system.

Print

This final utility is used to print song files in a tabular form similar to that displayed on the screen. The operator can select page modes which provide title headings and keep pages nicely separated.

Evaluation

While this system sounds compli-

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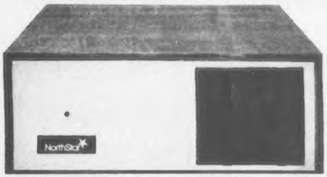

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cated, its use becomes extremely simple after a bit of practice. The documentation is generally excellent and helps the learning process greatly.

The screen-oriented editor and the tabular format make entry of even complex music reasonably straightforward. This system is probably as convenient as is possible for an ASCII-type entry code, although it is still no match for a graphics hardware/software package.

```
        *da capo
        *W 01 02 03 04
        *T 072
0003       S          A@5  R@4  R@4  D@3
0004       S          A@5  R@4  G@4  D@3
0005       S          A@5  R@4  F#4  E@3
0006       S          R@5  R@4  E@4  E@3
        *M 0001
        *C NUM1
        *C FIRST
        *C NUM1
        *C SECOND
        *X
        *L NUM1       1
0014       S          A@5  R@4  D@4  F#3
0015       S          A@5  R@4  F#4  F#3
0016       S          A@5  R@4  E@4  G@3
0017       S          R@5  R@4  D@4  G@3
0018       S          A@5  R@4  C#4  A@4
0019       S          A@5  G@4  B@4  A@4
0020       S          A@5  F#4  A@4  A@3
```

Listing I. Sample Editor Screen.

(J.S. Bach's *Es Ist Das Heil Uns Kommen Her* from the *Orgelbuchlein)* ½EDIT: text, cursors, I(nsert, X(cise, O(ptions, M(easure, quit

The music produced sounds very good. As the user becomes more proficient, use of more interesting waveforms, changing waveforms within a performance and other techniques can go a long way to avoiding the "music-box" sound of much computer music. The Newtech Model 6 music board performs well, although some waveforms can sound choppy due to sampling-rate limitations and other problems.

Musicraft does not contain any provisions for specifying attack or decay rates, staccato vs. legato renderings or any of several other useful musical techniques. Including such information would undoubtedly be possible at the expense of requiring more code to be entered.

All in all, Musicraft is an excellent program, well worth its reasonable cost to anyone using a DAC for music production. Combined with the Newtech board, a complete four-voice system can be purchased for under $200, which must be a bargain on today's market. □

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T/MAKER requires a 48K CP/M system, a total of 240K bytes of disk storage, CBASIC-2, and a CRT computer terminal with cursor addressing and clear screen.

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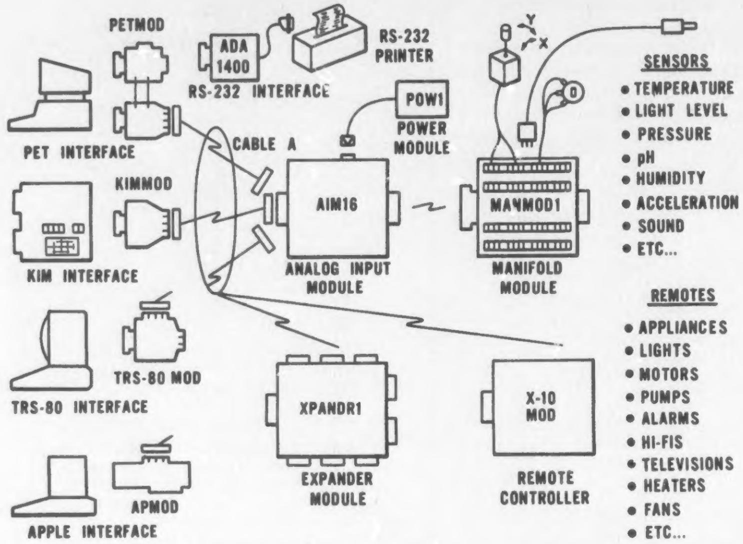
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APPLE INTERFACE

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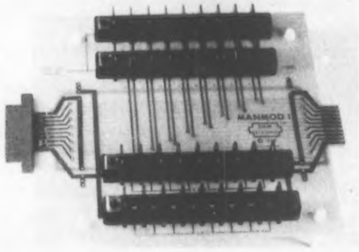
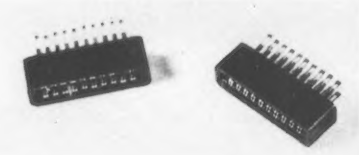
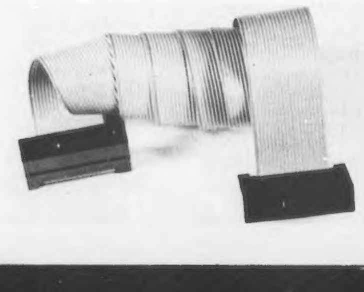
Connectors

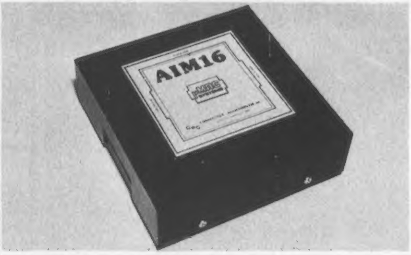




The AIM 16 requires connections to its input port (analog inputs) and its output port (computer interface). The ICON (Input CONnector) is a 20 pin, solder eyelet, edge connector for connecting inputs to each of the AIM16's 16 channels. The OCON (Output CONnector) is a 20 pin, solder eyelet edge connector for connecting the computer's input and output ports to the AIM16.

The MANMOD1 (MANifold MODule) replaces the ICON. It has screw terminals and barrier strips for all 16 inputs for connecting pots, joysticks, voltage sources, etc.

CABLE A24 (24 inch interconnect cable) has an interface connector on one end and an OCON equivalent on the other. This cable provides connections between the uMACSYSTEMS computer interfaces and the AIM 16 or XPANDR1 and between the XPANDR1 and up to eight AIM 16s.

Analog Input Module



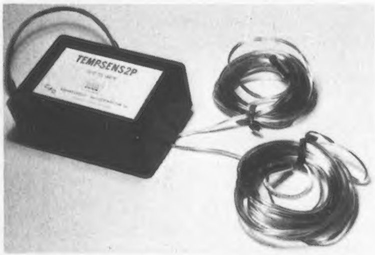
The AIM 16 is a 16 channel analog to digital converter designed to work with most microcomputers. The AIM16 is connected to the host computer through the computer's 8 bit input port and 8 bit output port, or through one of the uMAC SYSTEMS special interfaces.

The input voltage range is 0 to 5.12 volts. The input voltage is converted to a count between 0 and 255 (00 and FF hex). Resolution is 20 millivolts per count. Accuracy is 0.5% ± 1 bit. Conversion time is less than 100 microseconds per channel. All 16 channels can be scanned in less than 1.5 milliseconds.

Power requirements are 12 volts DC at 60 ma.

The POW1 is the power module for the AIM16. One POW1 supplies enough power for one AIM16, one MANMOD1, sixteen sensors, one XPANDR1 and one computer interface. The POW1 comes in an American version (POW1a) for 110 VAC and in a European version (POW1e) for 230 VAC.

TEMPSENS

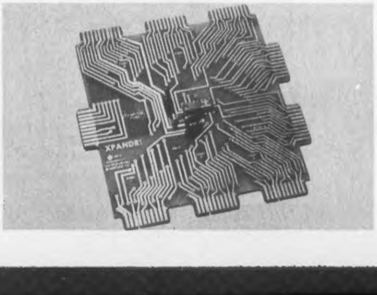

TEMPSENS2P

This module provides two temperature probes for use by the AIM16. This module should be used with the MANMOD1 for ease of hookup. The MANMOD1 will support up to 16 probes (eight TEMPSENS modules).

Resolution for each probe is 1°F.

XPANDR1

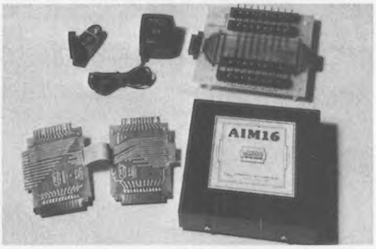
The XPANDR1 allows up to eight Input/Output modules to be connected to a computer at one time. The XPANDR1 is connected to the computer in place of the AIM16. Up to eight AIM16 modules are then connected to each of the eight ports provided using a CABLE A24 for each module. Power for the XPANDR1 is derived from the AIM16 connected to the first port.

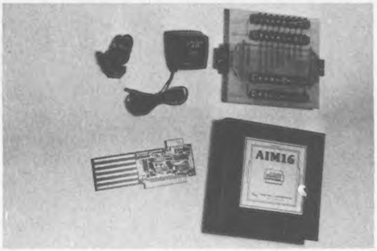


CONTROL for PET, Apple, KIM, and AIM

μMAC SYSTEMS

Computer Interfaces and Sets





For your convenience the AIM16 comes as part of a number of sets. The minimum configuration for a usable system is the AIM16, one POW1, one ICON and one OCON. The AIM16 Starter Set 2 includes a MANMOD1 in place of the ICON. Both of these sets require that you have a hardware knowledge of your computer and of computer interfacing.

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MANMOD1 (MANifold MODule)	**59.95**
CABLE A24 (24 inch interconnect cable)	**19.95**
XPANDR1 (allows up to 8 Input or Output modules to be connected to a computer at one time)	**59.95**
TEMPSENS2P1 (two temperature probes, -10°F to 160°F)	**49.95**
LIGHTSENS1P1 (light level probe)	**59.95**

The following sets include one AIM16, one POW1, one OCON and one ICON.

AIM16 Starter Set 1a (110 VAC)	**189.00**
AIM16 Starter Set 1e (230 VAC)	**199.00**

The following sets include one AIM16, one POW1, one OCON and one MANMOD1.

AIM16 Starter Set 2a (110 VAC)	**239.00**
AIM16 Starter Set 2e (230 VAC)	**249.00**

The following modules plug into their respective computers and, when used with a CABLE A24, eliminate the need for custom wiring of the computer interface.

PETMOD (Commodore PET)	**49.95**
KIMMOD (KIM, SYM, AIM65)	**39.95**
APMOD (APPLE II)	**59.95**
TRS-80 MOD (Radio Shack TRS-80)	**59.95**

μMAC SYSTEMS

Order Form

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BROOKFIELD, CONNECTICUT 06804
TEL: (203) 775-9659 TWX: 710-456-0052

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creative computing
WORD PROCESSING PROFILE

Would you believe a nice little word processor from *DWO QUONG FOK LOK SOW*, 23 East 20th St., New York, NY 10003, 212/685-2188?

Bargain - Basement Word Processing

Charles Platt

One of the best-kept secrets in word processing is WP6502, a program that I've been using in my work as a freelance writer during the past three months. WP6502 is unusual in that you can use it with a mere 8K of RAM — ideal, if you have a very small system. The program is modestly priced at $75 (tape, 5" or 8" disk) but has a surprising range of capabilities.

Currently WP6502 is only compatible with Ohio Scientific computers. Versions for Apple, PET and Atari are forthcoming; in the meantime, note that if you use WP6502 with the new Ohio Scientific C1 Series 2 (which has a decently legible text display of 48 characters per line, unlike the old C1, and still costs only $479 in its tape-driven version) you could put together a whole word processing system, including a printer, for under $1,000!

How versatile would such a system be, and how fast would it respond? Taking the second question first, WP6502 is written entirely in machine language so it does its job very quickly. It's just as fast as, say, Wordstar, and it has none of the bugs of, say, Electric Pencil.

As for versatility, I'll describe the features and you can judge for yourself.

When you load WP6502 it shows you its "menu" of options — a very short, simple menu whose choices include Type, Line Edit, Global Edit and View. You choose an option by pressing the corresponding key letter — almost all the program's functions are controlled this way, making them easily remembered, and you seldom have to press more than one key.

Press T, and WP6502 acknowledges that you can now Type your text. And it tells you how much room is available in memory for what you are about to write. (On my 24K machine I can write about 2,000 words before I have to stop and store them on disk.)

WP6502 automatically "normalizes" the Ohio Scientific keyboard, so that the shift keys work like those of an ordinary typewriter. This means that a trained typist does not have to learn new routines — the equipment adapts to the individual, rather than vice-versa.

When you start typing, the text appears at the bottom of the screen. Each time you fill a line the program automatically starts you on a new line, without allowing any words to be broken. And it does this extremely quickly, so you really can type in an unbroken stream, as fast as you want to.

A trained typist does not have to learn new routines — the equipment adapts to the individual, rather than vice-versa.

To backspace you press the "rub out" key, located where the backspace key would be on a typewriter. Backspacing erases text, so you can wipe a small error and retype it.

To go back to an error on a preceding line, you have to go into Line Edit mode. You do this by simply pressing the return key. You can now scroll the text up and down by pressing the "line feed" key. Scroll till the error you want to fix is at the bottom of the screen (all line editing is done on the bottom line) and then hold down the space bar to move the cursor along the line till it marks the right spot.

You now have three new options: Insert, Replace, or Delete. Press I to insert; this marks the spot where text is to be inserted, and lets you type as much as you like. Press the return key when you're through and WP6502 immediately shows you the completed correction.

If you press R for Replace, the old text is overwritten letter by letter. If you press D to Delete, you erase text one letter at a time and the remaining text moves up to fill the gap. Or press D then W to delete one word at a time, or D then S to get rid of a whole sentence.

You can now go back to Type mode again by pressing T. Or you can get back to the menu by pressing the return key, if you want to select other options . . . such as Global Edit. This is a standard feature, not substantially different from other word processing programs, allowing you to change a recurring word or phrase each time it appears in your text. WP6502's global editing routine is notable for being very fast, and for asking your approval before completing each alteration (it shows each proposed change to you, and you press Y or N in response).

So much for the basic features. What about layout? WP6502 does allow you to control the layout of your text, including tabs, paragraph indents, new margins and so on. These functions are controlled by embedded commands which you insert in your text while you are typing. For instance, to start a new paragraph you type #P. To indent a margin by fifteen spaces you type #M15. To tab in by 6 spaces you type #T06. To change to double line spacing you type #S2.

You do not *see* these layouts while you are typing. The commands only take effect when the text is being printed out. Or, you can inspect how the text is going to look if you select V from the menu, to View what you have done. This presents the properly formatted text on the screen in numbered "pages," one "page" being a screen-full. This way you get advance warning of any mistakes you have made which otherwise would not show up until print-out time.

When you're ready to print, you answer a series of questions, including: Lines per page? WP6502 pre-sets this at 66, but you can type in any other value up to 99. Margin? WP6502 sets it at 10, but you can change that as you wish. Column width? It's usually 60 characters, but you can type a different value. Number of copies: Select from 1 to 99. AP? This means "AP style," in which the program starts each new page with a new paragraph, and never breaks a paragraph at the bottom of a page. Hold? Answer "yes" to this, and WP6502 stops at the top of each new page so that you can sheet-feed your printer if you wish.

Charles Platt, P.O. Box 556, Old Chelsea Station, New York, NY 10113.

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CIRCLE 137 ON READER SERVICE CARD

Printout then commences. It will interrupt, incidentally, at any point where you have used the embedded command #K in your text. #K means "entry from keyboard"; the printout stops, you type in any special text you want, on the computer keyboard; the printer copies this into the printout, and then continues. This feature is ideal for putting individual names on form letters, for example.

Another business aid built into WP6502 is its Block Text feature — the most sophisticated of the options, and designed to be extremely easy to use. At any time you are in Type mode you can notify the program that the text you are about to produce should be considered as a separate block. You can create up to 99 such blocks. Each is identifiable and retrievable by number. So you can store a whole lot of standard business phrases as separate blocks of text, and then call them up in any sequence, to create "customized" form letters — or legal agreements which use different permutations of standard clauses. Block text can be mixed with ordinary text, you can use each block more than once, and you can store the blocks of text on a disk and load them into the computer before you start work.

It's as fast as Wordstar and it has none of the bugs of Electric Pencil.

So much for the things that WP6502 can do. What can't it do? Well, it can't justify text to produce columns with a straight right-hand edge. That capability will be offered in a separate "justification package," in preparation. What else won't the program do? It won't underline. It won't allow you to hyphenate words when you print narrow columns (WP6502 never allows words to be broken). And it won't give you a running heading at the top of each page. (It does give you page numbers, though — whether you want them or not!)

The absence of these features must be balanced against the economy and simplicity of WP6502. It is remarkably easy to operate this system, by contrast with more elaborate programs which show you the layout of your text as you type it and offer you a bewildering range of options for modifying what you see. Such programs generally cost about three times as much as WP6502 and require about six times as much memory.

WP6502 has only been available, in its current version, for a matter of months. It is unobtrusively establishing itself among Ohio Scientific users, but no one else seems to have heard of it. In due course, as new versions are produced for Apple, Atari, et al, we may see WP6502's cost-effective advantages becoming more widely recognized. □

WHAT IF

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T/MAKER integrates numerical and text data and can then print out final hard copy scrolls. Thus, many scribes are now free to work on my pyramid.

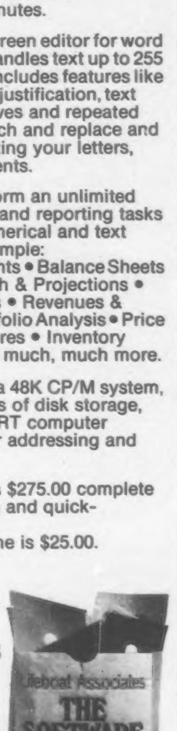
T/MAKER is a wonderful tool for data analysis. It is easy to set up calculations for rows and columns of tabular data, automatically perform the computations, review the results and then modify some of the data to see the impact on the over all results. Several days of manual work can be accomplished in minutes.

T/MAKER is a full screen editor for word processing which handles text up to 255 characters wide. It includes features like text formatting and justification, text buffer for block moves and repeated inserts, global search and replace and commands for printing your letters, reports and documents.

T/MAKER can perform an unlimited number of analysis and reporting tasks which integrate numerical and text processing. For example:
• Financial Statements • Balance Sheets • Statistics • Growth & Projections • Profitability Reports • Revenues & Expenditures • Portfolio Analysis • Price Lists • Rate Structures • Inventory Valuation. . . . . and much, much more.

T/MAKER requires a 48K CP/M system, a total of 240K bytes of disk storage, CBASIC-2, and a CRT computer terminal with cursor addressing and clear screen.

T/MAKER system is $275.00 complete with documentation and quick-reference card.
Documentation alone is $25.00.



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Educational Software

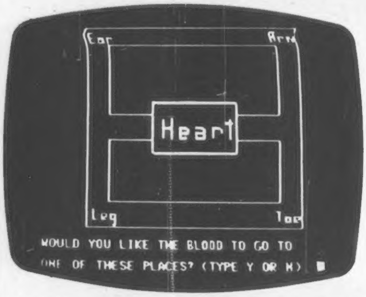
Part II

David Lubar

Last month skimmed the surface; educational programs are available in an extraordinary variety of styles, philosophies, and qualities. This month brings some new products, and some glances back at other products from companies mentioned last month.

Micro Power and Light

Circulation ($29.95) for 32K Apples with Applesoft in ROM and one disk drive contains a nice combination of text, high-resolution diagrams, and animation. The program gives instruction on six topics; blood, heart, arteries, capillaries, veins, and lungs. Each section first introduces the concept, then tests the user's understanding by asking questions. The program makes appropriate responses to both right and wrong answers. The strong point of *Circulation* is the high degree of interaction between computer and student. There is little chance that anyone's attention will drift in the middle of a lesson. When done with a segment, the user is given the choice of reviewing the material, moving on, or quitting. There is also a game on the disk; a race between two trucks. The player has to answer true/false questions. If the right answer is given, the player's truck dashes ahead; on a wrong answer, the computer's truck wins the heat.



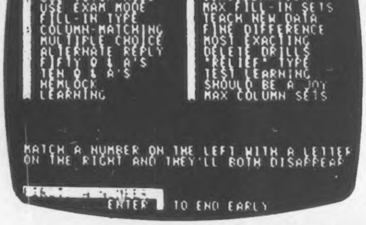
```
WOULD YOU LIKE THE BLOOD TO GO TO
ONE OF THESE PLACES? (TYPE Y OR N)
```

Interactive graphics comprise a large part of circulation.

The program, designed for students from fifth grade up to junior high, and for adults who need a refresher course, is well designed and pleasant to use. The documentation, though brief, contains complete instructions for loading the disk and for recovering from accidental resets.

Stoneware Microcomputer Products

Aristotle Apple ($34.95) runs on any Apple with 48K, disk, and Applesoft. It could be the answer to a teacher's prayers. The program allows the creation of tests. While this revelation might not sound exciting at first, the combination of solid programming, ease of use, and several user options makes this package very valuable. The teacher, using the "Editor" program, can create tests of three types; multiple choice, column matching, and fill in. With the multiple choice version, five choices are entered. The fifth choice is always either "All of the above" or "None of the above." These two are entered with "A" or "N," thus saving a bit of typing. The other choices can be up to 40 characters long, and the question can be as long as 75 characters. Column matching places two columns on the screen. The student picks a selection from the first column and tries to match it with the correct member of the second column. The fill-in test presents a question, then waits for the answer. The teacher has the option of entering two answers. This is useful, since some questions can be answered correctly in more than one way.



```
USE TUTOR MODE          CONSIDERATION
USE EXAM MODE           MAX FILL-IN SETS
FILL-IN TYPE            TEACH NEW DATA
COLUMN-MATCHING         FINE DIFFERENCE
MULTIPLE CHOICE         MOST EXACTING
ALTERNATE REPLY         DELETE DRILLS
FIFTY Q & A'S           "RELIEF" TYPE
TEN Q & A'S             TEST LEARNING
HEMLOCK                 SHOULD BE A JOY
LEARNING                MAX COLUMN SETS

MATCH A NUMBER ON THE LEFT WITH A LETTER
ON THE RIGHT AND THEY'LL BOTH DISAPPEAR

               ENTER   TO END EARLY
```

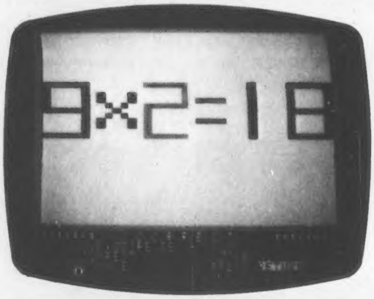
A column matching quiz from Aristotle's Apple.

The "Editor" program also allows for changes in tests and for deletion of tests. To do mass deletion, there is a program called "Hemlock." (The connection between Aristotle and hemlock was not explained in the documentation. It was Socrates who took that unkindest cup of all.) Students can also run the tests in a "Tutor" mode that presents the questions in an interactive manner.

The disk comes with enough documentation to get anyone going. Stoneware recommends making a back-up copy and saving the original in a safe place. After this, the user should run "Hemlock" to delete the example test files on the copy. If this isn't done, the sample tests will always appear when a student runs the program.

Muse

The *Elementary Math Edu-Disk* ($39.95) runs on a 48K Apple with versions available in Applesoft or Integer Basic. This program presents math problems in large characters that are formed using the low-resolution screen. Before starting the problems, the program can give a test which determines whether the student is ready for the material. An option allows



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The Home Computer Revolution	2.00
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The Impact of Computers on Society and Ethics: A Bibliography	17.95
Katie and the Computer	6.95
Problems for Computer Solution-Student Edition	4.95
Problems for Computer Solution-Teacher Edition	9.95

Save!

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Reprint: Word Processing	.50

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Creative Computing (25 issues from Vol. 3, No.4 to Vol. 6, No. 7)	$50.00
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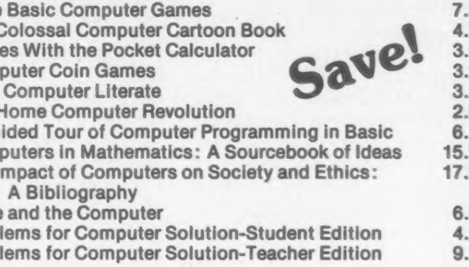

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Software, cont'd. . .

the problems to be accompanied with a voice. Coming through the Apple's speaker, the voice is understandable and adds interest to the program. During the presentation of the problems, incorrect answers produce graphic tutorials on the misunderstood concept. Blocks and numbers move around the screen, demonstrating and breaking down math operations. This part is nice, but one of the demonstrations takes a long time, and some students might lose interest. On the nice side, the disk keeps track of the student's score. The number of times a section has been worked, and the number of correct answers, is preserved until the teacher (or a budding young computer crime genius) deletes the file.

TYC Software

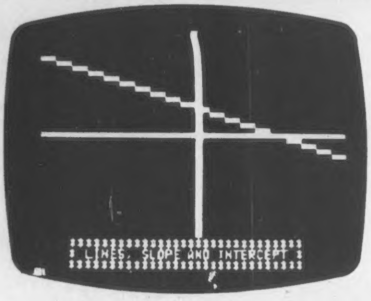
The *Individual Study Center* for 16K Level II TRS-80 and Apple II with Applesoft ($39.95 plus $1.50 p&h) represents a nice idea with executions that vary from excellent to poor. The package comes with a sample data tape, a maintenance program for creating data tapes, and six programs that use the data tapes. These six programs all present tests in the form of games. "Beat the Clock" allows the user to select the level of difficulty by picking a time limit from 30 minutes for twenty questions to 10 seconds per question. A clock appears on the screen along with the questions. At the end, the player is shown the correct answers.

While "Beat the Clock" is well done, "House on Fire" has some flaws that could frustrate the player. The game opens with graphics of a burning house. Each correct answer puts another rung on a ladder. Each mistake removes the rungs. The problem is that any question which is answered incorrectly is repeated over and over until the right answer is found. If the player doesn't know the answer, he is stuck.

Once again, the concept is good, and the ability to create data is very handy. Despite the problem with some of the games, the package could be useful in a classroom.

Cook's Computer Company

Cook's produces some nice programs for the Apple II. Since they are presently reorganizing their disk selections, prices can't be quoted, but some of the programs definitely deserve mention. *Take It or Leave It* builds math ability through a game. The player competes with the computer, deciding whether to take or leave the results of arithmetic problems that are shown on the screen. The goal is to build up the score, so the player has to determine whether the result is positive or negative. *Slope* gives a variety of questions that test understanding of concepts dealing with slope and graphs. Incorrect answers are well handled. The questions range from simple to fairly advanced. *Legacy* gives multiplication practice in the form of a game. The player tries to amass more dollars than the computer by getting to the right spot on a grid first. The grid has integers at the top and side, and the correct location for each number is the spot with a row and column value that, when multiplied together, produce the target number. *Alcohol,* which strongly resembles a program from *Creative Computing*, takes the user's body weight and the amount of liquor imbibed, then gives the percentage of alcohol in the blood and the effects that will probably occur. (Seeing the result of drinking 30 shots in one hour is rather sobering experience.) The program also contains some nice comments. If a ridiculous weight is entered, the reply is, "I didn't know elephants could operate a computer. Quit kidding and enter your real weight."

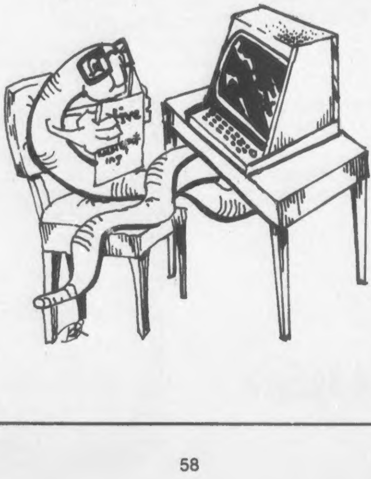


A game of Astro Quotes in progress.

This should give some idea of the variety available from Cook's Computer Company. For specific prices and available disks, it would be best to contact the company.

Micro Learningware

Grammar Package 1 for Level II 16K TRS-80 ($14.95) contains six programs that test recognition of parts of speech such as adverbs, adjectives, and pronouns. A sentence appears on the screen and the user can get one word at a time to appear in a box. Pressing "enter" when the right word is in the box produces a nod from an android on the screen. A wrong answer produces a message, but then jumps right back to the same point in the program. The package also contains a test of person, place, or thing, where the user has to put nouns in the correct box.



The math programs, *Elementary Math Packages I* and *II* ($14.95 each) contain drills, some tutorials, and a few games. The drills are fairly straightforward, but again they do not handle incorrect answers very well. The games aren't too bad; most of them are exercises in metrics. The main problem is the lack of true interaction in the educational programs.

Microphys

A large selection of educational programs for the PET are available from this company at $20 per tape. *Gram-Molecular Weight* presents problems in chemistry, giving a formula and asking for the molecular weight of the molecule. If the user has trouble, the problem is broken down for him, and he is asked the weights of the individual elements in the molecule. All Microphys programs come with instructions for retrieving the student's results and grade.

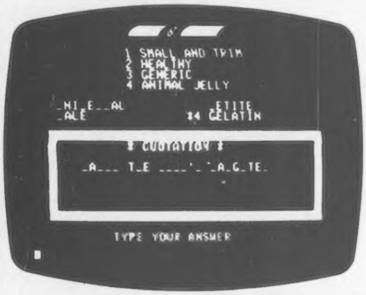
Linear Kinematics presents graphs, then asks questions about acceleration, speed, and related areas. The graph shows the instantaneous speed of a car, plotted against time. Five questions are presented with each graph. Each run presents different graphs.

In his September PET column, Gregory Yob had some strong criticism against Microphys. While some of his points are well taken if the tapes are intended solely for instruction, the tapes function best when used to supplement, not replace, classroom instruction. The full line from Microphys is too long to list here, but interested educators might want to write for their catalog.

Program Design, Inc.

This company markets a wide selection of educational software, almost all of which is available for both Apple and TRS-80, with some available in PET format. *Astro Quotes* ($14.95) is a nice twist on standard word games. The player has to guess a quotation. Underlined spaces show the number of words and letters in the quote. Above the quote are four definitions, also supplied with blanks. When a correct word is found for one of the definitions, the letters in that word are placed at all points in the quote where they appear. The maximum score is obtained by getting all four words before guessing the quote. There are three skill levels and over 150 quotes in memory.

While *Astro Quotes* is useable as either a game or educational product, PDI also markets programs with specific educational intent. *Spelling Builder* ($18.95) contains eight programs and an audio tape. The programs take the user through a few basic rules, building up spelling ability as well as facility in accenting and syllabification. The programs work well, though there is one weak point. There is no branching when several incorrect answers are given. The user has to keep trying until he gets it right. An occasional hint would be nice. Aside from that, the programs are good. The audio tape overcomes one of the major problems of spelling programs. When words are presented on the screen, the user sees the correct spelling. PDI's use of audio tape allows spelling tests that actually test the user's ability. A program is used along with the audio portion, and the words are presented in groups of ten, allowing the user to stop when he wants and continue at a later time.



```
1 SMALL AND TRIM
2 HEALTHY
3 GENERIC
4 ANIMAL JELLY

_NI_E__AL          _ETITE
_ALE            #4 GELATIN

# QUOTATION #

_A___ T_E ____'_ _A_G_TE_

TYPE YOUR ANSWER
```

The opening of Cook's Slope program.

Suffixes ($14.95) gives a tutorial on several common endings. There are five programs. The first present "meter" and "gram". Later programs test learning. Throughout each program there are multiple choice questions. Again, there is no branching on incorrect answers.

The PDI line seems varied and well done. All of their Apple tapes are available on disk for an extra $5. Those in need of this type of software could probably fill many of their requirements here.

Tandy Corporation

Radio Shack has produced a rather massive educational package for the TRS-80. The *K-8 Math Program* ($199.95) contains drills and tests in mathematics for students from kindergarten to eighth grade. The students are locked into the programs, but the teacher, by hitting two certain keys in a row, can access the system to check results and make changes in the problems. In the first four levels, correct answers are rewarded with a smiling graphic face. The package contains tapes, disks, and extensive instructions, all bound in a sturdy notebook. The math lessons have several modes. They can be used for placement, as skill-building exercises, or as tests.

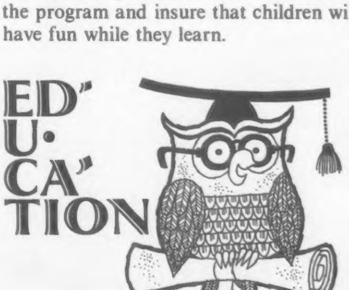
The programs for the lower grades are supplemented with graphics, the upper levels use text and put prompting messages on the screen if the student doesn't give an answer within fifteen seconds. The drills go through operations in a step-by-step manner, with the student filling in one number at a time, including a carry whenever it is produced. Brighter students might become a bit impatient with this approach, but it does reinforce the proper procedure for doing arithmetic.

A young student using the system for the first time should be guided through the exercises so he knows what to expect. Once started, any child should be able to continue on his own with this package.

Texas Instruments

A variety of educational cartridges are available for owners of the TI-99/4. *Early Learning Fun* is ideal for young children. It contains learning games that deal with numbers, shapes, and letters. The shape exercises are especially nice. In one, a shape appears on the right side of the screen, and the player has to match it to one of the shapes on the left side. When a choice is made, the test shape moves across the screen and pauses next to the selection. The letters section gives exercises in letter recognition, accompanied with pictures for each letter.

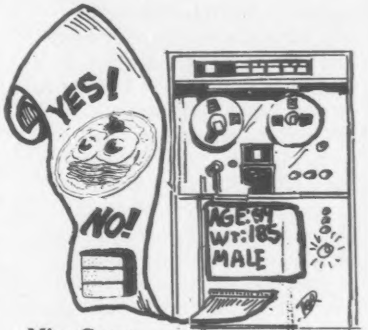
Beginning Grammar has sections on nouns, adjectives and other parts of speech. Each section is presented with a different theme. For example, "Adjective's Restaurant" uses the inside of a menu to present the problems. Another one uses a bus and traffic signal, with red or green flashes to signal wrong or right answers. The programs are nicely designed to ignore bad input from the keyboard such as numbers or punctuation marks. Music and sounds through the monitor add interest to the program and insure that children will have fun while they learn.



Number Magic gives several types of quizzes. The user has many options, including a choice of working against time or working without a limit. The level of the problems goes from simple to fairly difficult. All of the Texas Instrument Cartridges come with extensive booklets and make full use of the excellent sound capabilities of the TI-99/4.

Personal Software

The *Vita Facts* series for Apple, PET, and TRS-80 contains cassettes on several crucial topics, including *Heart Attacks* and *Birth Control*. Each package consists of an audio tape and a program. The audio tape contains the information. After listening to it, the user runs the program, taking multiple-choice quizzes to test his retention and comprehension. This use of audio data is nice since it allows the listener to gain a great deal of information without the eyestrain associated with long sessions in front of a monitor. The topics are valuable to older students and to adults.



MicroComp

While designed as a utility and data base, *Nutri-Pak* for the Apple has educational value. The user first establishes a file for himself which contains his age, sex and weight. He can then select foods from the data base, or add his own foods, and determine how these foods contribute to his daily requirements of vitamins and minerals. The program is easy to use and makes it possible to investigate different diets. Many foods are included on the disk; adding others is simple to do.

Updates

Time for a quick mention of some things that didn't make it into last month's review. Among the products from **Steketee** that weren't covered is a nice math program, *Speed Drill*. This presents problems with a time limit and is well designed. **Edu-Ware** also has a nice math package, *Compu-Math*. **Image** produces games as well as educational programs. These will be covered in a review of Atari software which is scheduled for a later issue. Most educational software is

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Software, cont'd. . .

designed for ages from elementary school to high school. **Conduit** produces programs for college students. Their programs didn't reach here in time for this review, but will be covered in the near future.

Again, this review just touches the surface. The exclusion of any particular program or manufacturer is a matter only of fate, postal peculiarities, and deadlines, bearing no reflection on quality or lack of quality. Educators and parents should have little trouble finding a program that comes close to fulfilling their requirements. ☐

Educational Software Vendors

Cook's Computer Company
1905 Bailey Drive
Marshalltown, IA 50158

Micro Comp
2015 N.W. Circle Blvd.
Corvallis, OR 97330

Micro Learningware
Box 2134
N. Mankato, MN 56001

Micro Power and Light
1108 Keystone
13773 N. Central Expressway
Dallas, TX 75243

Microphys
2048 Ford
Brooklyn, NY 11229

MUSE
330 N. Charles St.
Baltimore, MD 21201

Program Design, Inc.
11 Idar Court
Greenwich, CT 06830

Personal Software, Inc.
1330 Bordeaux Drive
Sunnyvale, CA 94086

Stoneware
1930 Fourth St.
San Rafael, CA 94901

Tandy Corp.
One Tandy Center
Fort Worth, TX 76102

Texas Instruments, Inc.
P.O. Box 10508
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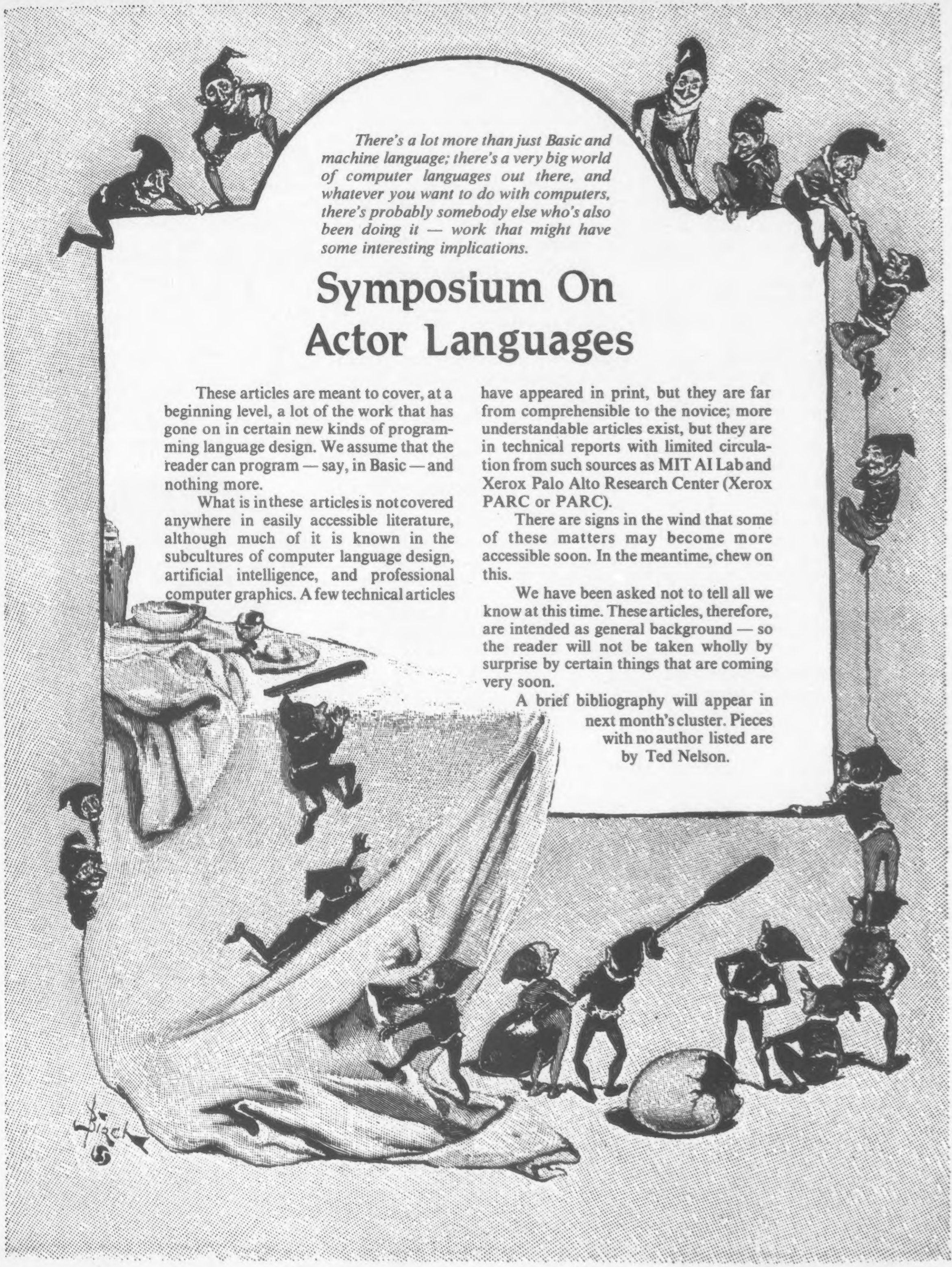

There's a lot more than just Basic and machine language; there's a very big world of computer languages out there, and whatever you want to do with computers, there's probably somebody else who's also been doing it — work that might have some interesting implications.

Symposium On Actor Languages

These articles are meant to cover, at a beginning level, a lot of the work that has gone on in certain new kinds of programming language design. We assume that the reader can program — say, in Basic — and nothing more.

What is in these articles is not covered anywhere in easily accessible literature, although much of it is known in the subcultures of computer language design, artificial intelligence, and professional computer graphics. A few technical articles have appeared in print, but they are far from comprehensible to the novice; more understandable articles exist, but they are in technical reports with limited circulation from such sources as MIT AI Lab and Xerox Palo Alto Research Center (Xerox PARC or PARC).

There are signs in the wind that some of these matters may become more accessible soon. In the meantime, chew on this.

We have been asked not to tell all we know at this time. These articles, therefore, are intended as general background — so the reader will not be taken wholly by surprise by certain things that are coming very soon.

A brief bibliography will appear in next month's cluster. Pieces with no author listed are by Ted Nelson.

Computer languages are a religious issue; they always have been, always will be. By this I mean that people's commitment to their preferred computing languages are strong and emotional; that argument about the subject, while it may incorporate rational elements, rapidly generates anger and ill feeling; that a person's chosen favorite language reflects (often visibly — perhaps always) deep aspects of his personality; and that adopting a new computer language has the quality of religious conversion, including ferocious brighteyed conviction and enthusiasm, trances, and the invocation of magical requests.

Your chosen language also incorporates your vision of the hereafter — or rather, what sort of rewards you think are deserved for what sorts of effort and privation. (There are punitive religions and languages, demanding long and painful devotion with little reward; there are pie-in-the-sky religions and languages, promising wonderful rewards for little effort — usually just after some upcoming event, like the next holy war, or in the next version to be implemented.)

I say this as preface to discussing the newer families of language in the advanced reaches of the computer field, fully aware that many readers will get angry right at the beginning. Having learned Basic, they see the grueling travail behind them; it was good enough for Dad, it's good enough for me. Well and good. Go away and don't read this.

People in the computing community seem to be awaiting the appearance of some kind of "Everyman's Computer Language". This is a self-contradiction. The ultimate computer language should have *nothing* to do with computers, but be some kind of general purpose problem solving language. (Think of musical notation — does it refer to the hardware at all?)

So we're talking about two problems — 1) hiding the meaningless internals of the machine (most programming languages are baby-steps toward this goal) and 2) thinking in very rigid, but abstract ways. Solving problems *at all* with or without machines is not easy. — *Steve North*

The personal computing field is roughly ten years behind the times in language development. Today's popular languages, like Basic and Pascal, are where computer research was quite a while ago.

Have you adjusted to them? Good. Now step onto the rocket sled for a fast trip into the present, and brace yourself.

The Zoo Story

Interacting Critters Make Up the New Electric Circus

There are many things which cannot be done in languages of the Fortran type — or hadn't you noticed? Big systems get harder to program as they get bigger. Some things can't be programmed at all sensibly in conventional languages. This leaves you several choices. One is to say, "that is not what computers are for," and give up. Another is to take a deep breath and plunge into the icy depths of machine language.

Still another possibility is to work out hacks in whatever languages you *do* have, heedless of the inefficiency and escalating complication. (This is sometimes called "clever programming.") But whatever you do by these methods you are locked into for good, and you are swamped by complications which increase geometrically with the size of the project.

Anything can be built on top of anything else in the computing field.

But several questions at once emerge: How stupid is it? How permanent does it have to be? and How efficient is it? (Typically you lose an order of magnitude in speed for each layer.)

Is there an answer?

Can big programs ever be created easily?

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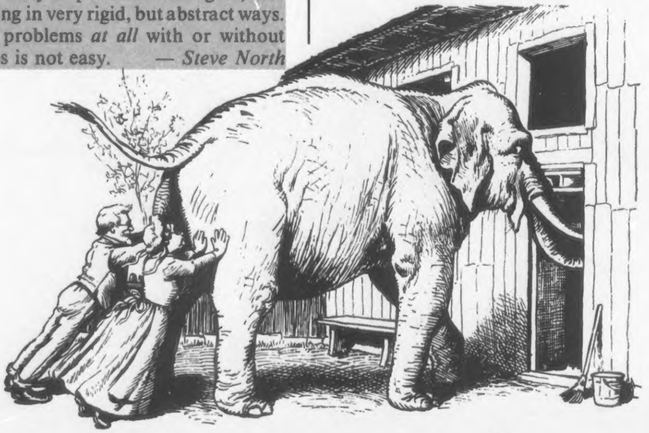


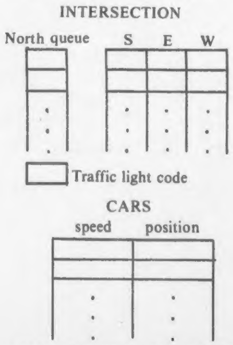
A Brief Introduction To Actor Languages

The Actor languages represent important and powerful new concepts; their structure is totally upside-down and inside-out from all other computer languages. Previous knowledge of other computer languages appears to be no help whatever in learning them. (Whether beginners learn them more easily than experienced programmers is not yet clear.)

Actor languages are customizable and extensible, with particular power for graphics. Changes and additions in command structure can be made easily and rapidly.

With Actor languages you do not write "programs" in the usual sense. You define "classes of Actors" instead, scripts that enable the individual Actors to play their parts.

For instance, suppose you wanted to simulate traffic at an intersection, and that you wish to represent cars entering and leaving this intersection and its approaches. In a customary computer language (say, Basic), you might declare an array for the cars and an array for the four approaches to the intersection.



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Smalltalk and the Personal Computer

by Robert M. Gravina, Associate Professor of Mathematics, Department of Mathematics,
University of Lowell, Lowell, Massachusetts 01854

The personal computer can be regarded as the newest example of human mediums of communication. Various means of storing, retrieving and manipulating information have been in existence since human beings began to talk. External mediums serve to capture internal thoughts for communication and, through feedback processes, to form the paths that thinking follows. Although digital computers were originally designed to do arithmetic operations, their ability to simulate the details of any descriptive model means that the computer, viewed as a medium, can simulate any other medium, if the methods of simulation are sufficiently well described. Moreover, unlike conventional mediums, which are passive in the sense that marks on paper, paint on canvas and television images do not change in response to the viewer's wishes, the computer medium is active: it can respond to queries and experiments and can even engage the user in a two-way conversation.

Abstract
The future increase in capacity and decrease in cost of microelectronic devices will not only give rise to compact and powerful hardware but also bring qualitative changes in the way human beings and computers interact. In the 1980's both adults and children will be able to have as a personal possession a computer about the size of a large notebook with the power to do virtually all their information-related needs. Computing and storage capacity will be many times that of current computers: tens of millions of basic operations per second will manipulate the equivalent of several thousand printed pages of information.

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The quality of the images generated through computer simulations on high-resolution television displays should eventually be possible to present on compact personal computers. Frames of pictures from dynamic-simulation programs that revise an image several times per second to represent the continuous motion of objects in projected three-dimensional space are already in evidence. Simulation depicting a space laboratory being lifted out of the interior of a space shuttle and the movement of tankers in New York harbour are common. The ability of the personal computer to simulate real or imagined phenomena will make it a new medium of communication.

CONTINUED ON PG. 72

Smalltalk— A View From The Bottom

Tom Dinnella

At Computer Methods we write almost everything in assembly language. It takes a long time to write and is difficult for the uninitiated to follow, but the code runs like lubricated lightning. We work at the operating system level where speed is important. This gives us a strange view of computing, a view from the machine perspective — the bottom.

With these facts in mind, we have been evaluating a higher level language called Rosetta Smalltalk for possible use in intelligent terminal applications. Here are our impressions, not so much of the Rosetta product, which is still in its prototype stage, but of Smalltalk as a new language for computing.

Tom Dinnella, Computer Methods, 523 Hansen Road, King of Prussia, PA 19406.

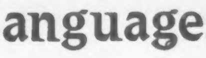
CONTINUED ON PG. 82

Two Directions Of Actor Languages

Actor languages go in two directions. On the one hand, the continuing Smalltalk work at Xerox PARC has been focused for almost a decade toward the creation of the "Dynabook" — a programmable display computer of great power, nominally for children (if they can get it away from the nearest adult).

Ordinarily, new products are created for a constituency that has asked for them, or at least can imagine them. The Dynabook is something else again. The Dynabook goal has been hard for many people to believe, but the falling prices of high-power chips and plasma screens begin to make it seem believable after all. Watch this space.

Meanwhile, Artificial Intelligence has turned to the Actor languages as a new and liberating tool, allowing simplification and decentralization of its ever-more-intricate software endeavors.



Syntax Should Be Extensible

(as in smalltalk)

Mark Miller

We all know how different languages are best suited to different tasks. For certain types of problems, I might choose to program in Lisp, for other things, C or APL. Each of these has a flavor of expression best suited to certain ways of doing things. The trouble with designing a new specialized language for each new kind of problem is that actual programs typically have to do various different types of things.

On some systems it might be possible to write different parts of the problem in different languages, and then hook all the parts together. There are two difficulties with this:

First, and more obviously, different languages in general have different representations of data, and the complexity of hooking the modules together so they can communicate may be great.

Mark Miller, Project Xanadu, Box 128, Swarthmore, PA 19081.

CONTINUED ON PG. 86

Introduction, cont'd...

Then you could write a stretch of program that accesses the different variables, studies and modifies them.

In Actor languages, however, this is turned inside-out. You define a class *car*, say, but no space is allocated to individual cars. Here is what goes in core:

Class Definition of "Car"

Class Variables, and space for them (accessible to all members of class).

a/	b/
c/	

List of Variables each "car" actor will need

d, e, f, g.

Method: how the Actors respond to messages.

Now, dynamically, suppose a car comes into being or happens on the scene. An Actor is created; the language processor allocates space for this particular instance of the class:

CAR

Class: CAR	Name: Jalopy 2
Variables: d/ e/ f/ g/	

As additional instances come into being, they are dynamically allocated space in core; as they are no longer needed, their space is freed.

Note that any Actor, no matter how complex, may be a data field in another actor. Thus by increments we may build up to any level of complexity.

An Object is its Responses

The guiding metaphysic of the language is this: an Actor is what it *does.* Its private data are of no concern to the outside world; the outside world, or the rest of the programming environment, has a right to ask it certain things and it will reply with certain responses. This is a behaviorist view. An Actor "is" only what it does, the way it responds to the messages it gets. And so to program in Actor languages is to define (and redefine) what Actors do when spoken to in particular ways.

CONTINUED ON PG. 70

The Zoo Story, cont'd...

Sketchpad and its Original Magic

Today's story begins with the Sketchpad system — as does much of the modern computer world.

The first computers with big core memory were built experimentally around the late fifties. One of these was the TX-2 at MIT. (Actually at Lincoln Labs in suburban Boston.)

While "computer graphics" had already been put into use in the SAGE system — the continental air-defense system of the late fifties — they weren't used for much else.

A graduate student named Ivan Sutherland thought that the big TX-2 computer would be an awfully nice tool for interactive work, especially making engineering drawings.

He got a grant and access to the big machine, and created a program called Sketchpad. It was original, elegant and historic. Much of computer science has stemmed from it, as will much of tomorrow's world.

The flow of control is simplified: you don't have to decide "what happens next." What happens, happens.

Sketchpad allowed you to draw on the screen with a light-pen. Moreover, it allowed the creation of "instances" of a basic shape, and "constraints" upon it. We'll explain.

Let's say you draw a basic shape — a rectangle — on the screen with your light-pen. (Naturally, the coordinates are grabbed by the program and stored in memory, so that the computer is able repeatedly to draw the rectangle to refresh its image on the screen.)

The "instances" feature allowed you to make multiple copies on the screen of a shape already stored in memory, and placed them around the screen in different sizes. What this meant internally, of course, was that the system made a *master* copy of the data structure you had drawn, and secondary copies which had specific sizes and positions.

The "constraint" concept is this. Suppose you have drawn a crooked rectangle on the screen. You may, using Sutherland's Sketchpad program, command two lines of that depicted rectangle to form a right angle. Thereupon they make the appropriate changes — on the data structure, and on the screen. "Right angle" in this example is a *constraint.*

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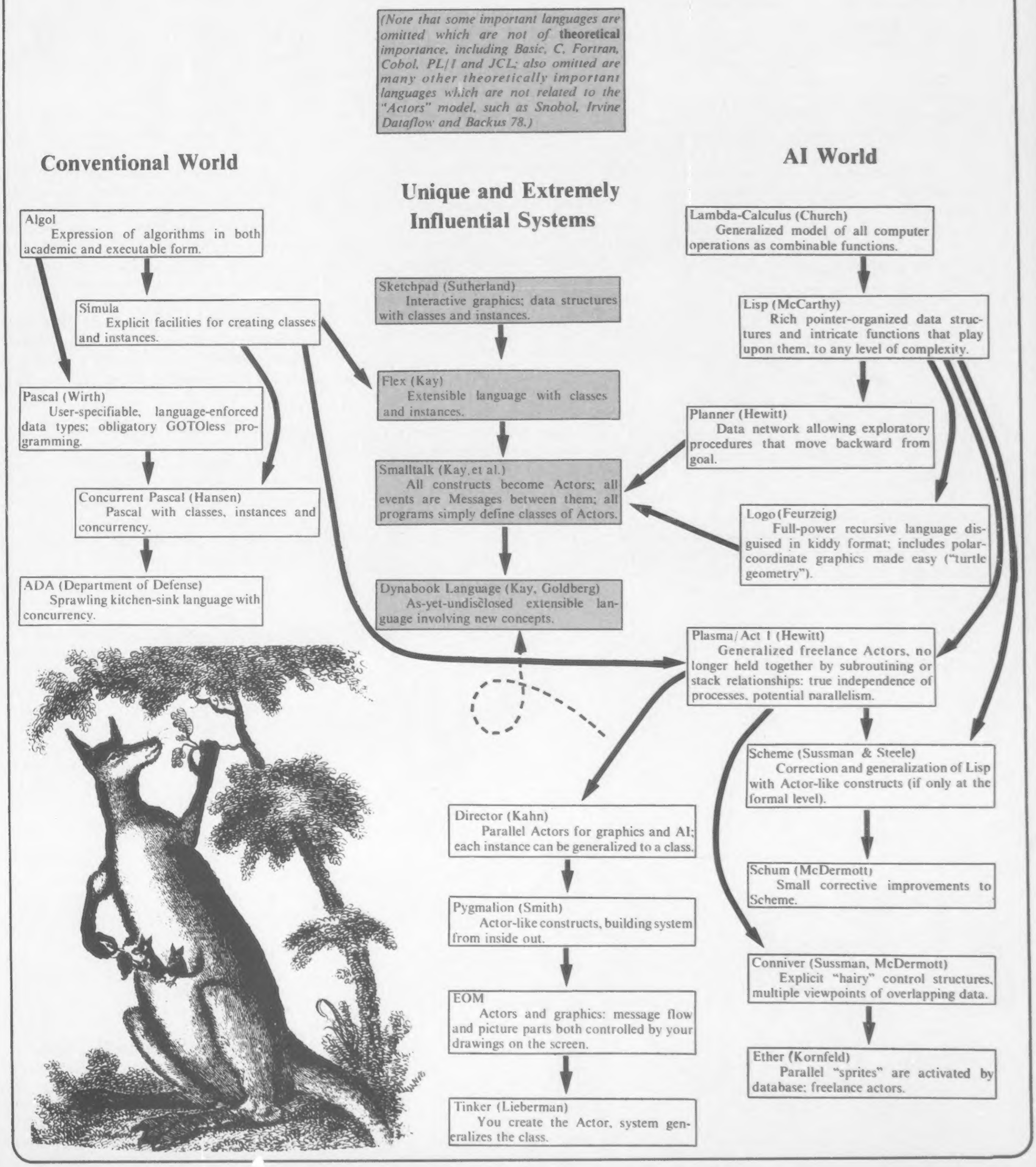
Family Tree Of Actor Languages

Topology by Mark Miller; Captions by Ted Nelson.



(Note that some important languages are omitted which are not of **theoretical** *importance, including Basic, C, Fortran, Cobol, PL/I and JCL; also omitted are many other theoretically important languages which are not related to the "Actors" model, such as Snobol, Irvine Dataflow and Backus 78.)*

Conventional World

Algol
Expression of algorithms in both academic and executable form.

Simula
Explicit facilities for creating classes and instances.

Pascal (Wirth)
User-specifiable, language-enforced data types; obligatory GOTOless programming.

Concurrent Pascal (Hansen)
Pascal with classes, instances and concurrency.

ADA (Department of Defense)
Sprawling kitchen-sink language with concurrency.

Unique and Extremely Influential Systems

Sketchpad (Sutherland)
Interactive graphics; data structures with classes and instances.

Flex (Kay)
Extensible language with classes and instances.

Smalltalk (Kay, et al.)
All constructs become Actors; all events are Messages between them; all programs simply define classes of Actors.

Dynabook Language (Kay, Goldberg)
As-yet-undisclosed extensible language involving new concepts.

Director (Kahn)
Parallel Actors for graphics and AI; each instance can be generalized to a class.

Pygmalion (Smith)
Actor-like constructs, building system from inside out.

EOM
Actors and graphics: message flow and picture parts both controlled by your drawings on the screen.

Tinker (Lieberman)
You create the Actor, system generalizes the class.

AI World

Lambda-Calculus (Church)
Generalized model of all computer operations as combinable functions.

Lisp (McCarthy)
Rich pointer-organized data structures and intricate functions that play upon them, to any level of complexity.

Planner (Hewitt)
Data network allowing exploratory procedures that move backward from goal.

Logo (Feurzeig)
Full-power recursive language disguised in kiddy format; includes polar-coordinate graphics made easy ("turtle geometry").

Plasma/Act I (Hewitt)
Generalized freelance Actors, no longer held together by subroutining or stack relationships: true independence of processes, potential parallelism.

Scheme (Sussman & Steele)
Correction and generalization of Lisp with Actor-like constructs (if only at the formal level).

Schum (McDermott)
Small corrective improvements to Scheme.

Conniver (Sussman, McDermott)
Explicit "hairy" control structures, multiple viewpoints of overlapping data.

Ether (Kornfeld)
Parallel "sprites" are activated by database; freelance actors.

The Zoo Story, cont'd...

Simula

Take another line of development, a language called Simula.

Simula descended from Algol. Let's talk about that for a minute. Algol is of course the Fortran-like language created by mathematicians for expressing processes and algorithms exactly.

Algol has gone in many directions. On the one hand it has become a full computer language; its descendant, Pascal, is very popular (even though it restricts the programmer in various ways — especially, denying him close access to the machine level).

On the other hand, Algol has become a "test bed" for language experimentation, since its syntax is well known and lots of Algol processors exist that can be retooled with new added features.

One such retooling is Simula, an Algol developed in Norway for "simulation" programming by Ole-Johan Dahl and Kristen Nygaard.

The idea of simulation programming is basically that a lot of little things are running around in your data structure — automobiles or submarines or other objects in an imaginary setting — and the language has to keep track of them as they come into existence, affect each other, and go away.

In Simula, these classes of "objects" have properties that can be defined, like the shapes permitted in Sketchpad; defining these properties was like creating Sketchpad constraints; and instances of these objects could come and go, just like the instances of a specific picture in Sketchpad. But these objects and their instances were above and beyond the underlying Algol framework.

Special K

Enter Alan Kay.

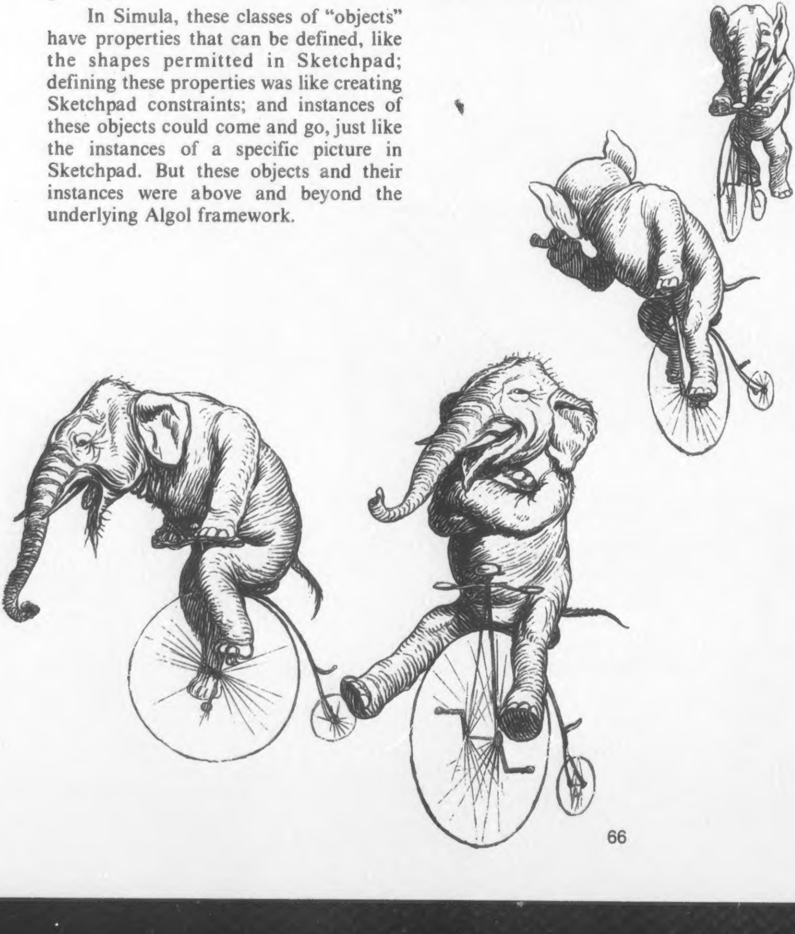
Alan Kay, when a young programmer (and a particularly talented one), was exposed closely to both Sketchpad and Simula.

In both of them — Sketchpad and Simula — he saw pre-defined data structures that could spawn as many instances as necessary. These instances could come and go and interact as required.

We can look back at Charles Darwin's voyage — as the official naturalist of the H.M.S. Beagle — and see it as an extraordinary unfolding of all the evidence Darwin needed to discover the theory of evolution. At the ship's ports of call he saw one thing after another that contributed to his thinking: an earthquake that left the land higher than before; the people of Tierra del Fuego, living naked in the cold and damp, but adapted to their environment; seashells high in the Andes; and a cluster of islands whose finches had become visibly different. Many pieces, one puzzle, one picture, one single big idea, *obvious* now.

So too, for Alan Kay. Smalltalk, Simula. Classes and instances. One picture.

Why shouldn't a computer program just be collections of separate objects that respond to each other?



This leaves one question unanswered, however. How should all these entities intercommunicate?

There are basically two choices. One choice would have the intercommunication between the instances take place through some large data table — like a bulletin board or newspaper — where entities put their results and inquiries. This would mean, however, many problems as to where the information from or to a given thing was to be put; and problems with data being accidentally squished by the wrong part of the program.

Kay made the other choice, an inspiration whose consequences are still spreading.

Why not, he thought, have the entities send *messages* to each other?

Here was the heart of a complete new kind of programming system: where teeming infestations of objects, predefined responders all, send messages to each other, and react by sending other messages in turn.

Kay's Ph.D. thesis, at the University of Utah, was called *The Reactive Engine.* And in his work since, he has pursued the variety and consequences of such reactive entities.

(Woof)

In Simula, you had a conventional programming system (Algol) for handling such things as arithmetic, logical comparison, strings, and so on. But then you could create more unusual data structures as classes of interacting object.

Kay asked mischievously, "Why not have just the interacting objects?"

The language Kay has developed could be described as "Simula without the Algol." To put it in Zen terms, imagine a dog barking; now take out the dog.

The languages that have resulted, then, throw out the conventional mechanisms of ordinary declarative programming. Instead of having a single overall plan, carried out by the computer as a supervisor or deity, there are classes of Actors which follow scripts. The scripts tell them how to respond to messages; they do so; and that's all.

For instance, consider arithmetic. "3+4" is no longer evaluated in the conventional fashion as part of some larger expression. Rather, "3" is an *actor,* and the plus-symbol is a *message to the 3.* The 3 is an actor of the class integer. When an integer gets the "plus" message, the next thing it does is look for the next part of the message; if it's another integer, it adds it to itself!

Now, if you are used to Basic or Fortran or Pascal, this is all very strange. But the point is that it reduces the fundamental mechanism of a computer language to a single sweeping structure: *Look at your message, and act accordingly.*

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creative computing

David Ahl, Founder and Publisher of Creative Computing

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The Zoo Story, cont'd...

The Diaspora

These languages have evolved in many directions. Their varieties are many and fascinating; their future is unclear. From Kay's fundamental work at the University of Utah, things have gone in various directions. Many researchers have been affected.

In the artificial intelligence community — particularly the AI labs of MIT and Stanford — numerous projects and languages have been developed for a number of purposes around this concept.

The systems evolving in the MIT/AI axis have been tied to the traditions of artificial intelligence. Most are built as front ends on one variety or another of Lisp — languages like ACT I, Director, Ether. Carl Hewitt of MIT has introduced the term "actors" for the multifarious interactive beasties that these languages generate. We'll use this term here, because it is mentally more emphatic than the term "object" (used by the Smalltalk school). The Actor metaphor also suits the AI community better because it tends to resemble the way they think of mentalities and mental processes — as little guys sent off on missions.

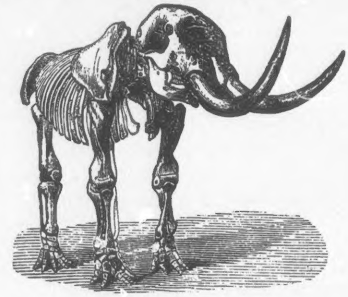
Kay himself went to Xerox Palo Alto Research Center (PARC), and has worked in a rather difficult direction. Teamed with Adele Goldberg, another dynamic individual, and various hard-driving collaborators,* he has produced a number of languages based on these ideas.

And in the Learning Research Group at PARC — the LRG, now headed by Goldberg — they have exercised these languages in astonishing new ways.

Their announced goal has been to produce something called the *Dynabook*. This Dynabook isn't a book at all, but a high-powered computer with a high-resolution display screen and a high-power extensible language. It is intended to be sold for a few hundred dollars and to be used by children. (Since presumably adults will be allowed to use it as well, such a device might have an interesting impact upon our society and customs. We leave it to the reader — and our letters column — to speculate upon such matters.)

Smalltalk

The Smalltalk effort, through its different versions (see Mark Miller's comparison piece in the November issue), has concentrated on the notion of an extensible language. Each type of Actor "understands" specific input messages or sequences of messages. This has been done with an eye to the user's customizing his own extensible language — except that the "commands" of a language are really the message-words that a given type of Actor understands. (There is also an interesting trick here: if two different types of Actors are set up to respond to the same message-word, like, say, "edit" or "show," that message-word comes to seem like a general command of the language. In fact it is a different script for each type of actor. We may call this distinctive approach *distributed parsing.*



In the Smalltalks, sending a message to an Actor is essentially the same as calling a subroutine. The Actor does its thing, then returns control (and message) only to the Actor that called it. If an Actor calls other Actors, they are essentially its subroutines.

No such restrictions apply in the hairier AI Actor languages.

Actor Languages in the AI Lab

The AI approach has taken a different direction.

Typically, the Actor languages at MIT, Stanford and kindred places have been built upon one or the other variety of Lisp; the power of Lisp, once available, is not easily pried away from a language designer. Some of these variations have been intended for teaching children. Many have been used for computer graphics. And some like ACT I, have been used for studying "the mathematical theory of computation" — that is, flow-of-control issues at the heart of programming itself. (Indeed, Hewitt's ACT I research has found such flow-of-control mechanisms as the GOTO, the subroutine and the recursive call to be variations of new primitive structures.)

AI researchers have used Actor languages to model "social processes" among separate cognitive functions, and to model "social processes" among multiple program entities. They have been used to model "knowledge-based systems" and database operations. They have been used every whichway.

Advantages of Actor Lanaguages

Most simply put, the Actor language allows you to have many different kinds of *things* operating in a program at once. Their interaction can be specified in a way something like the real world — "Car A sees that Car B is too close," or "The face tells its mouth to smile." The flow of control is simplified: you don't have to decide "what happens next." What happens, happens. You don't have to know, when you write the program, how many there are of each particular thing.

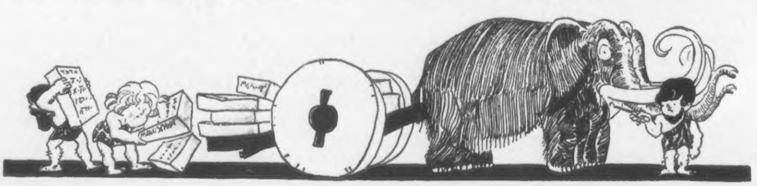
Programming consists of telling the different classes of actors how to respond to the messages they receive. (Whereas *firing up* a program — initialization — consists of setting up how many actors of each class happen to be on stage, and what their opening messages are.)

Changing a program simply means changing the responses of the actors, incrementally — adding to their lists of things to do and the circumstances under which to do them.

Parallelism among processes — and, in the future, within multi-processor computer systems — become easier to handle in software.

Importantly, portions of programs can *defend themselves* — that is, an Actor can guard against, and ignore, messages not of the right type. (This is of course possible in normal programming, but through a more elaborate system of checking procedures; Actors do it naturally.)

The most important aspect, however, is that *complexity does not escalate as programs get big.* Syntax extension, plus the orderly grouping of subunits and orderliness of message passing, effectively maintain a neatness of organization that stays together as systems get "large." More and more complexity may be added to a system without changing its structure — new Actors, new classes, more intricate behavior for old classes.



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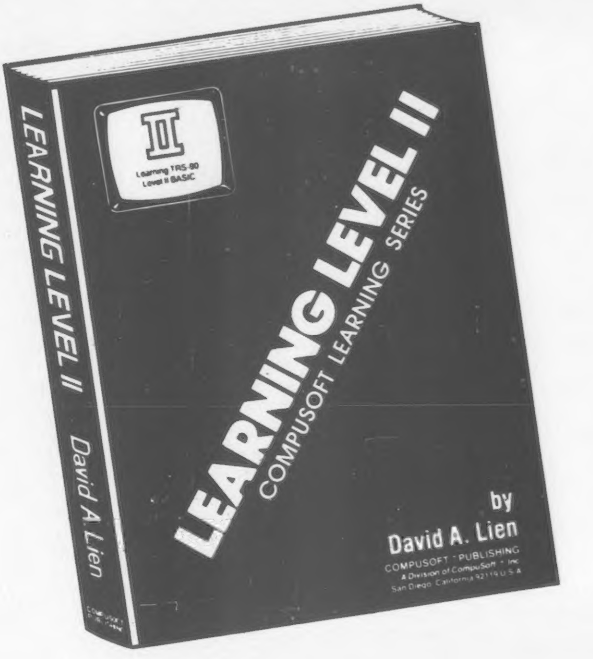
*To mention anyone is taking a chance of offending dozens who worked on these projects; we must leave it to that group to sort out the credit properly at a later time.

Here's The Second Half . . . . .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The Zoo Story, cont'd...

Commonalities and Differences

The different Actor systems have much in common. All are extensible, permitting you to add new commands easily. Some are extensible in ways that keep the control structure simple. Those with hair, like ACT I, don't.

The systems that are intended to be easy for beginners — the Smalltalks and, for instance, Director — have two levels. The easy level is learned quickly — but it's only a small fraction of the system, and to learn the rest — the "real" system — is a very steep hill indeed, perhaps climbed only by high-level programmers.

The general syntaxes — the ways in which scripts are written — differ in every possible way. The Smalltalks, indeed, are very different among themselves; the AI languages go in every possible direction.

Typically, however, all the Actor languages are set up to show different levels to the programmer: program scripts are typically boxes that open, revealing more boxes with more scripts hidden in them. These are essentially the same as nested subroutines — but made graphically pleasing and grouped as convenient units.

Some have only two levels of structure: others have, essentially, classes of classes.

Some of the languages are interpretive (Smalltalk 72 and Rosetta), some of them compile (Smalltalk 76). Here's a good one: Director, which is interpretive, is written in MacLisp (also interpretive), but can be turned into optimized Lisp, which can in turn be compiled into machine code.

The Graphics

Both the AI and PARC developments have been closely wedded to graphics, especially the "turtle" graphics pioneered at MIT. (On the screen is an imaginary pen-point, pointing a certain way. It is called, never mind why, a Turtle. The user or program may cause it to draw straight lines or rotate the direction in which it is ready to draw.)

Large-scale dot graphics have also been powerfully merged with these languages, especially the Smalltalks. The PARC users have a standard 500 x 1000 screen, fine enough to offer a choice of typefonts. Even more spectacular have been the color animations achieved through a special color dot-matrix display built by Richard Shoup. The animated film samplers produced with this equipment, and driven by Smalltalk, have wowed educational audiences and computer-graphic professionals from coast to coast.

(Moreover, a particular style of multipanelled windowing graphics has come about in the Smalltalk community, closely related to the overlay animation in their spectacular films. Unfortunately, there is no space to discuss this here.)

While PARC people often talk as though graphics (and windows) were intrinsically part of the language, it's not that simple. I believe the real relation between snazzy graphics and such languages consists in their powerful capabilities for deep program revision and the orderly creation of big systems.

Inefficiency

All these languages are comparatively inefficient, in terms of program steps per clock cycle. To use them for number-crunching operations would be absurd. But, on the other hand, processing power is going up and software cost is going up and up and up — so the efficient use of *people,* not chips, is plainly the important concern of the future.

Among the AI freaks a different rationale may sometimes be heard: "Anything goes, because machine time is free." But that is just their little snobbish joke.

The Consequences

Where this is all going is very hard to say.

Certainly the influence of Actor languages at the cutting edge of the computer world has been extraordinary. There has been, however, no effect whatever in any sort of commercial or "practical" sphere. From the overt evidence, Actor languages have made nothing of any significance happen in the Real World, and those who insist on concrete evidence, and believe people in three-piece suits, think they're of no consequence at all. On the other hand, there are longhairs who think Smalltalk and its descendants will have the most explosive effect on the world since the integrated circuit. (Indeed, there are those who suspect even business programming may be upended by these developments.) But a stroll through the prominent AI labs might also give the impression that these developments are strictly for ivory tower loons.

And what is with Xerox?

And will there be a Dynabook? And when? And where does the line form?

We leave these questions to sizzle and pop. But perhaps not for long. ☐

Introduction, cont'd...

In an ordinary computer language, a piece of program has independent existence without input or output. In Actor languages, however, a thing is defined in terms of how it responds to things — so nothing is defined without input or output.

An Actor programmer ponders on the nature of an object, then defines its class in terms of what he wants the Actor to do in response to stimuli.

CLASS "DOG"

if you		it will
pet	⟹	lick hand
feed	⟹	eat
throw stick	⟹	run and bring it back

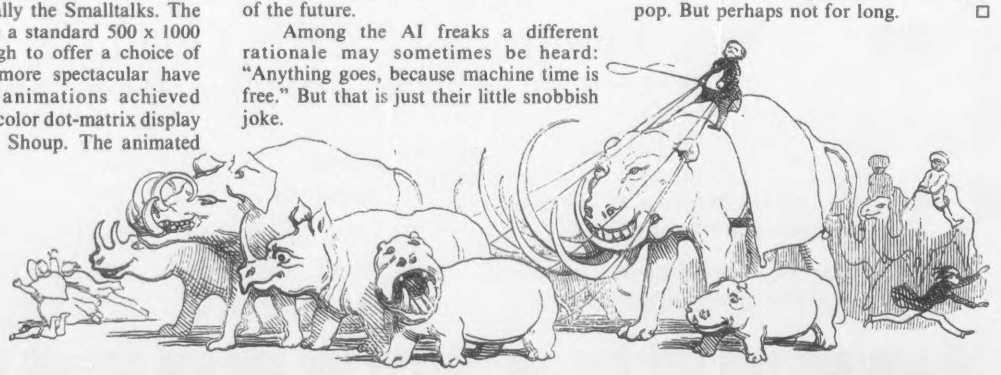
This is roughly what a class definition is Actor languages. The left column is a list of incoming messages to which the "dog" will respond; the right column is the list of responses. (The actual formalism the programmer must deal with may be very different, especially in the Lisp-based actor languages.)

Programming consists of making and revising such class definition lists. And that's all. Because all that happens is this:

INSTANCES OF OBJECTS
RECEIVE MESSAGES
AND RESPOND TO THEM
BY SENDING OTHER
MESSAGES.

What, then, is the "syntax" of Actor languages in the sense of standard grammatical arrangement of commands?

You might say that they have none. Each type of object recognizes certain messages to which it is prepared to respond. The Syntax is simply all the different messages to which all the different types of objects will respond. And this is something you can customize. ☐



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CIRCLE 127 ON READER SERVICE CARD

Personal Computer, cont'd...

The evolution of the personal computer has followed a path similar to that of the printed book, but in 40 years rather than 600. Like the handmade books of the Middle Ages, the massive computers built in the two decades before 1960 were scarce, expensive and available to only a few. Just as the invention of printing led to the community use of books chained in a library, the introduction of computer time-sharing in the 1960's partitioned the capacity of expensive computers in order to lower their access cost and allow community use. The Industrial Revolution made possible the personal book by providing inexpensive paper and machanized printing and binding, similarly the microelectronic revolution of the 1970's will bring about the personal computer of the 1980's, with sufficient storage and speed to support high-level computer languages and interactive graphic displays.

Ideally, the personal computer will be designed in such a way that people of all ages and walks of life can mould and channel its power to their own needs. Architects should be able to simulate three-dimensional space in order to reflect on and modify their current designs. Physicians should be able to store and organize a large quantity of information about their patients, enabling them to perceive significant relations that would otherwise be imperceptible. Composers should be able to hear a composition as they are composing it, notably if it is too complex for them to play. Businessmen should have an active briefcase that contains a working simulation of the company. Educators should be able to implement their own version of Socratic dialogue with dynamic simulation and graphic animation. Homemakers should be able to store and manipulate records, accounts, budgets, recipes and reminders. Children should have an active learning tool that gives them ready access to large stores of knowledge in ways that are not possible with mediums such as books.

We realized that children require more computer power than an adult is willing to settle for in a time-sharing system.

How can communication with computers be enriched to meet the diverse needs of individuals? If the computer is to be truly "personal", adult and child users must be able to get it to perform useful activities without resorting to the services of an expert. Simple tasks must be simple, and complex ones must be possible. Although a personal computer will be supplied with already created simulations, such as a general text editor, the wide range of backgrounds and ages of its potential users will make any direct anticipation of their needs very difficult. Thus the central problem of personal computing is that nonexperts will almost certainly have to do some programming if their personal computer is to be of more than transitory help.

To gain some understanding of the problems and potential benefits of personal computing individuals at the Xerox Palo Alto Research Center have designed an experimental personal computing system. They have had a number of these systems built and have studied how both adults and children make use of them. The hardware is faithful in capacity to the envisioned notebook-size computer of the 1980's, although it is necessarily larger. The software is a new interactive computer language called SMALLTALK.

The development of the Xerox personal computing system was in part influenced by the efforts in the late 1960's with the design of the FLEX, the first personal computer to directly support a graphics – and simulation – oriented language. Although the FLEX design was encouraging, it was not sufficiently comprehensive to be useful to a wide variety of nonexpert users.

At about the same time, the Xerox group became interested in the efforts of Seymour A. Papert, Wallace Feurzeig and others working at the Massachusetts Institute of Technology and at Bolt, Beranek and Neuman, Inc., to develop a computer-based learning environment in which children would find learning both fun and interesting. Working with a large time-shared computer, Papert and Feurzeig devised a simple but powerful computer language called LOGO. After working on Project Apollo for four years at M.I.T., I became acutely involved with LOGO and the Xerox group used many of our ideas in developing SMALLTALK. With the LOGO language, children (ranging in age from 8 to 12) could write programs to control a simple music generator, a robot turtle that could crawl around the floor and draw lines, and a television image of the turtle that could do the same things.

After completing this project, in time we came to realize that many of the problems involved in the design of the personal computer, particularly those having to do with expressive communication, were brought strongly into focus when children down to the age of six were seriously considered as users. We also realized that children require more computer power than an adult is willing to settle for in a time-sharing system. The best results that time-sharing can provide are crude green-tinted line drawings and square-wave musical tones. Children, however, are used to finger paints, colour television and stereophonic records, and they usually find the things that can be accomplished with a low-capacity time-sharing system insufficiently stimulating to maintain their interest.

The SMALLTALK system was guided by the FLEX and LOGO systems and by the central ideas of the programming language SIMULA, which was developed in the mid-1960's by Ole-Johan Dahl and Kristen Nygaard at the Norwegian Computing Center in Oslo.

The SMALLTALK experimental personal computer is self-contained and fits comfortably into a desk. Long-term storage is provided by removable disk memories that can hold the equivalent of 1,500 printed pages of information (about three million characters). Although image displays in the 1980's will probably be flat-screened mosaics that reflect light as liquid-crystal watch displays do, visual output is best supplied today by a high-resolution black-and-white or colour television picture tube. High fidelity sound output is produced by a built-in conversion from discrete signals to continuous waveforms, which are then sent to a conventional audio amplifier and speakers. The user makes his primary input through a typewriter-like keyboard and a pointing device called a mouse, which controls the position of an arrow on the screen as it is pushed about on the table beside the display. Other input systems include an organ-like keyboard for playing music, a pencil-like pointer, a joystick, a microphone and a television camera.

The designated activity will decide whether it wants to accept the message and later act on it.

The commonest activity on the personal computer is the manipulation of simulations already supplied by the SMALLTALK system or created by the user. The dynamic state of a simulation is shown on the display, and its general course is modified as the user changes the displayed images by typing commands on the keyboard or pointing with the mouse. For example, formatted textual documents with multiple typefaces are simulated so that an image of the finished document is shown on the screen. The document is edited by pointing at characters and paragraphs with the mouse and then deleting, adding and restructuring the document's parts. Each change is instantly reflected in the document's image.

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LEDGER 3 - lists both the the JOURNAL file and the CHART OF ACCOUNTS.

LEDGER 4 - computes the TRIAL BALANCE and executes POSTING of journal transactions into the CHART OF ACCOUNTS. An AUDIT TRIAL of all transaction is output.

LEDGER 5 - produces the PROFIT AND LOSS STATEMENT.

LEDGER 6 - produces the BALANCE SHEET. Assets, liabilities and owners' equities are shown by account and by totals. **$140.00**

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PAY 3 - reports outstanding Accounts Payables in four categories; under 30 days, 31-60 days, 61-90 days, and over 90 days.

PAY 4 - reports all outstanding Accounts Payables for a single customer or for all customers, and computes Cash Requirements.

PAY 5 - reports all outstanding Accounts Payables for a single date or for a range of dates and computes the Cash Requirements.

PAY 6 - lists both the Transactions and Master files.

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REC 3 - reports outstanding Accounts Receivables in four categories; under 30 days, 31-60 days, 61-90days, and over 90 days.

REC 4 - reports all outstanding Accounts Receivables for a single customer, or for all customers and computes Cash Projections.

REC 5 - produces reports for all outstanding Accounts Receivables for a single date or for a range of dates and computes Cash projections.

REC 6 - lists Transaction and Master files and accumulates and journalizes Accounts Receivables, creating JOURNAL entries which communicate with the MICROLEDGER JOURNAL file. **$140.00**

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This Inventory Control system presents a general method of Inventory Control and produces several important reports. Its program includes:

INV 1 - initializes Transaction and Master files and adds and updates Transaction and Master records.

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INV 3 - lists both Transaction and Master files.

INV 4 - produces the STOCK STATUS REPORT, showing the standard inventory stock data and stock valuation, and the ABC ANALYSIS breaking down the inventory into groups by frequency of usage.

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PERS 4 - computes Payroll and prints the PAYROLL REGISTER. Prints PAYCHECKS and creates JOURNAL entries to be fed into the MICROLEDGER JOURNAL file.

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CIRCLE 239 ON READER SERVICE CARD

Personal Computer, cont'd...

In many instances the display screen is too small to hold all the information a user may wish to consult at one time, and as a result "windows", or simulated display frames, were developed within the larger physical display. Windows organize simulations for editing and display, allowing a document composed of text, pictures, musical notation, dynamic animations and so on to be created and viewed at several levels of refinement. Once the windows have been created they overlap on the screen like sheets of paper; when the mouse is pointed at a partially covered window, the window is redisplayed to overlap the other windows. Those windows containing useful but not immediately needed information are collapsed to small rectangles that are labelled with a name showing what information they contain. A "touch" of the mouse causes them to instantly open up and display their contents.

In the present state of the art software development is much more difficult and time consuming than hardware development. The personal computer will eventually be put together from more or less standard microelectronic components, but the software that will give life to the user's ideas must go through a long and arduous process of refinement if it is to aid and not hinder the goals of a personal dynamic medium.

For this reason over the past four years 250 children (aged six to 15) and 50 adults were invited to try versions of SMALLTALK and to suggest ways of improving it. Their creations, as imaginative and diverse as they themselves, include programs for home accounts, information storage and retrieval, teaching, drawing, painting, music synthesis, writing and games. Subsequent designs of SMALLTALK have been greatly influenced and improved by the visitors' projects.

The particular structure of a symbolic language is important because it provides a context in which some concepts are easier to think about and express than others.

When children or adults first encounter a personal computer, most of them are already involved in pursuits of their own choosing. Their initial impulse is to exploit the system to do things they are already doing: a home or office manager will automate paperwork and accounts, a teacher will portray dynamic and pictorial aspects of a curriculum, a child will work on ways to create pictures and games. The fact is that people naturally start to conceive and build personal tools. Although man has been characterized as the toolmaking species, toolmaking itself has historically been the province of technological specialists. One reason is that technologies frequently require special techniques, materials, tools and physical conditions. An important property of computers, however, is that very general tools for using them can be built by anyone. These tools are made from the same materials and with the same effort as more specific creations.

Initially the children interact with the computer by "painting" pictures and drawing straight lines on the display screen with the pencil-like pointer. The children then discover that programs can create structures more complex than any they can create by hand. They learn that a picture has several representations, of which only the most obvious – the image – appears on the screen. The most important representation is the editable symbolic model of the picture stored in the memory of the computer. For example, in the computer an image of a truck can be built up from models of wheels, a cab and a bed, each a different colour. As the parts of the symbolic model are edited, its image on the screen will change accordingly.

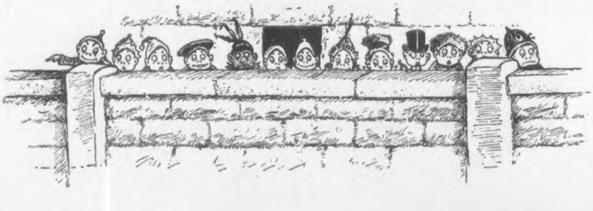
Adults also learn to exploit the properties of the computer medium. A professional artist spent several months building various tools that resembled those he had worked with to create images on paper. Eventually he discovered that the mosaic screen – the indelible but instantly erasable storage of the medium – and his new ability to program could be combined to create rich textures of a kind that could not be created with ink or paint. From the use of the computer for the impoverished simulation of an already existing medium he had progressed to the discovery of the computer's unique properties for human expression.

It is just this realm of apparent nonsense that must be kept open for the developing minds of the future.

One of the best ways to teach nonexperts to communicate with computers is to have them explore the levels of abstraction at which images can be manipulated. The manipulation of images follows the general stages of intellectual growth. For a young child an image is something to make: a free mixture of forms and colours unconnected with the real world. Older children create images that directly represent concepts such as people, pets and houses. Later analogical images appear whose form is closely related to their meaning and purpose, such as geometric figures and graphs. In the end symbolic images are used that stand for concepts that are too abstract to analogize, such as numbers, algebraic and logical terms and the characters and words that constitute language.

The types of images in the hierarchy are increasingly difficult to represent on the computer. Free-form and literal images can be easily drawn or painted with lines and halftones in the dot matrix of the display screen with the aid of the mouse or in conjunction with programs that draw curves, fill in areas with tone or show perspectives of three-dimensional models. Analogical images can also be generated, such as a model of a simulated musical instrument: a time-sequenced graph representing the dynamic evolution of amplitude, pitch variation and tonal range.

Symbolic representations are particularly useful because they provide a means of handling concepts that are difficult to portray directly, such as generalizations and abstract relations. Moreover, as an image gets increasingly complex its most important property, the property of making local relations instantly clear, becomes less useful. Communication with computers based on symbols as they routinely occur in natural language, however, has proved to be far more difficult than many had supposed. The reason lies in our lack of understanding of how human beings exploit the context of their experience to make sense of the ambiguities of common discourse. Since it is not yet understood how human beings do what they do, getting computers to enage in similar activities is still many years in the future. It is quite possible, however, to invent artificial computer languages that can represent concepts and activities we do understand and that are simple enough in basic structure for them to be easily learned and used by nonexperts.



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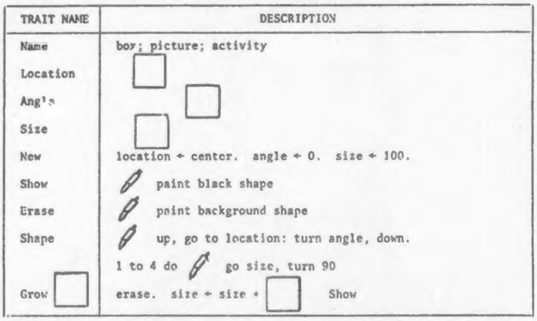
Personal Computer, cont'd...

The particular structure of a symbolic language is important because it provides a context in which some concepts are easier to think about and express than others. For example, mathematical notation first arose to abbreviate concepts that could be expressed only as ungainly circumlocutions in natural language. Gradually it was realized that the form of an expression could be of great help in the conception and manipulation of the meaning for which the expression stood. A more important advance came when new notation was created to represent concepts that did not fit into the culture's linguistic heritage at all, such as functional mappings, continuous rates and limits.

The computer created new needs for language by inverting the traditional process of scientific investigation. It made new universes available that could be shaped by theories to produce simulated phenomena. Accordingly symbolic structures were needed to communicate concepts such as imperative descriptions and control structures.

Most of the programming languages in service today were developed as symbolic ways to deal with the hadware-level concepts of the 1950's. This approach led to two kinds of passive building blocks: data structures, or inert construction materials, and procedures, or step-by-step recipes for manipulating data. The languages based on these concepts (such as BASIC, FORTRAN, ALGOL and APL) follow their descriptions in a strictly sequential manner. Because a piece of data may be changed by any procedure that can fit it the programmer must be very careful to choose only those procedures that are appropriate. As ever more complex systems are attempted, requiring elaborate combinations of procedures, the difficulty of getting the entire system to work increases geometrically. Although most programmers are still taught data-procedure languages, there is now a widespread recognition of their inadequacy.

A more promising approach is to devise building blocks of greater generality. Both data and procedures can be replaced by



TRAIT NAME	DESCRIPTION
Name	box; picture; activity
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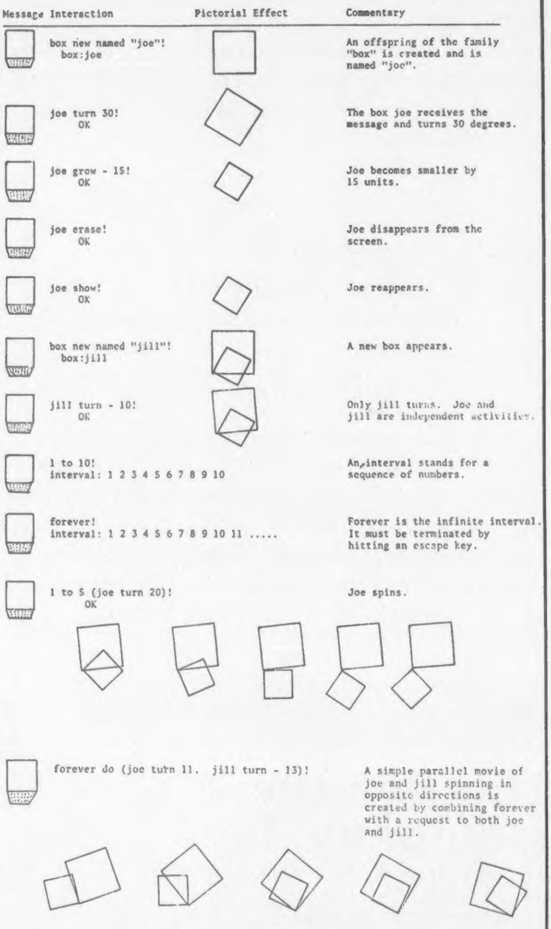
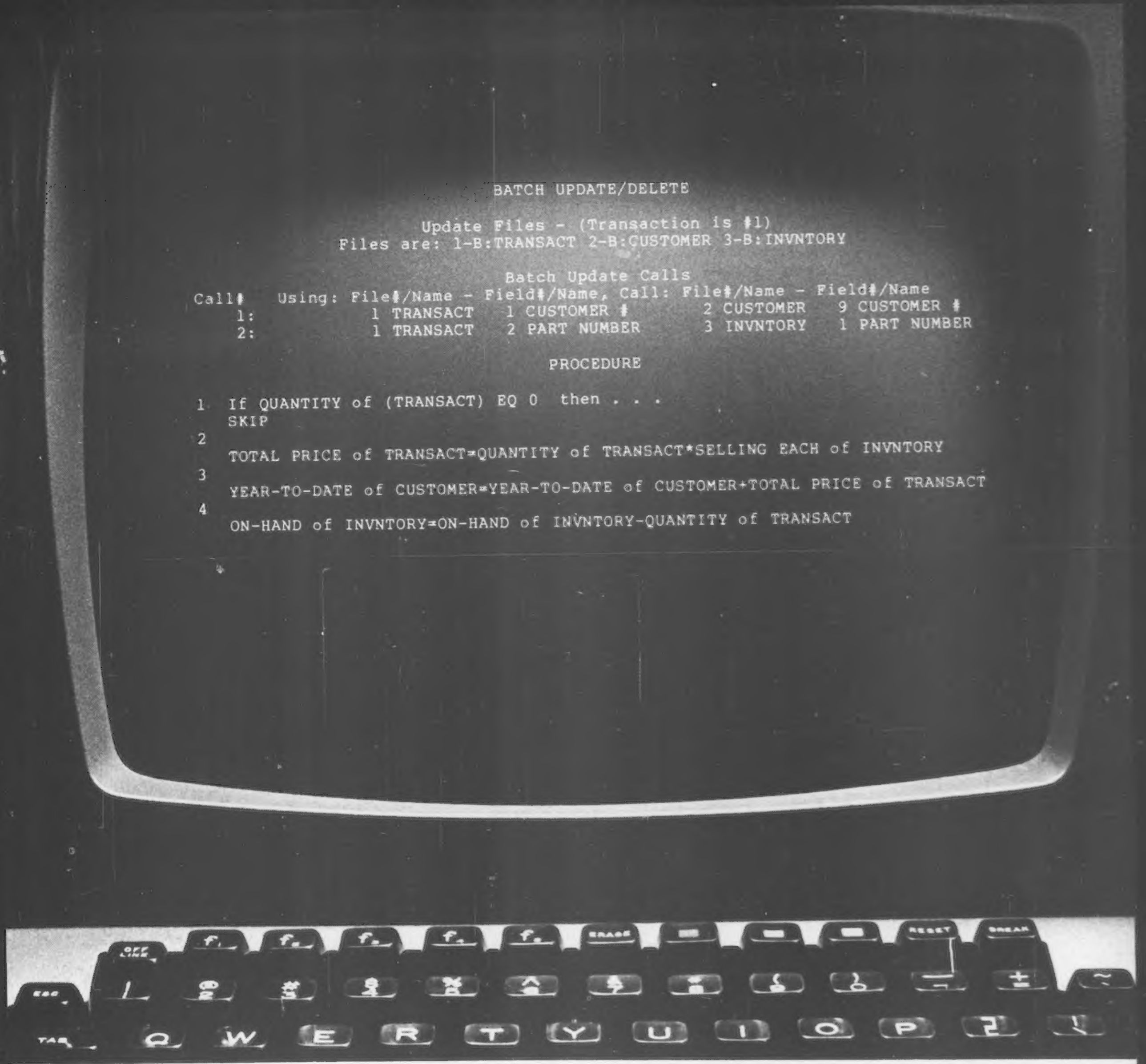
Angle	
Size	
New	location ← center. angle ← 0. size ← 100.
Show	paint black shape
Erase	paint background shape
Shape	up, go to location: turn angle, down.
	1 to 4 do go size, turn 90
Grow	erase. size ← size + Show

SMALLTALK is a new programming language developed at the Xerox Palo Alto Research Center for use on the experimental personal computer. It is made up of "activities", computer-like entities that can perform a specific set of tasks and can also communicate with other activities in the system. New activities are created by enriching existing families of activities with additional "traits", or "abilities", which are defined in terms of a method to be carried out. The description of the family "box" shown here is a dictionary of its traits. To create a new member of the family box, a message is sent to the trait "new" stating the characteristics of the new box in terms of specific values for the general traits "location", "angle", and "size". In this example "new" has been filled in to specify a box located in the centre of the screen with an angle of zero degrees and a side 100 screen dots long. To "show" the new box, a member of the curve-drawing family "brush" is given directions by the open trait "shape". First the brush travels to the specific location, turns in the proper direction and appears on the screen. Then it draws a square by travelling the distance given by "size", turning 90 degrees and repeating these actions three more times. The last trait on the list is open, indicating that a numerical value is to be supplied by the user when the trait is invoked by a message. A box is "grown" by first erasing it, increasing (or decreasing) its size by the value supplied in the message and redisplaying it.



Message Interaction	Pictorial Effect	Commentary
box new named "joe"! box:joe		An offspring of the family "box" is created and is named "joe".
joe turn 30! OK		The box joe receives the message and turns 30 degrees.
joe grow - 15! OK		Joe becomes smaller by 15 units.
joe erase! OK		Joe disappears from the screen.
joe show! OK		Joe reappears.
box new named "jill"! box:jill		A new box appears.
jill turn - 10! OK		Only jill turns. Joe and jill are independent activities.
1 to 10! interval: 1 2 3 4 5 6 7 8 9 10		An interval stands for a sequence of numbers.
forever! interval: 1 2 3 4 5 6 7 8 9 10 11		Forever is the infinite interval. It must be terminated by hitting an escape key.
1 to 5 (joe turn 20)! OK		Joe spins.
forever do (joe turn 11. jill turn - 13)!		A simple parallel movie of joe and jill spinning in opposite directions is created by combining forever with a request to both joe and jill.

SMALLTALK LEARNING SEQUENCE teaches students the basic concepts of the language by having them interact with an already defined family of activities. First, offspring of the family box are created, named and manipulated, and a second family of activities called "interval" is introduced. Offspring of the interval and box families are then combined to generate an animation of two spinning boxes.



```
                         BATCH UPDATE/DELETE

                  Update Files - (Transaction is #1)
         Files are: 1-B:TRANSACT 2-B:CUSTOMER 3-B:INVNTORY

                          Batch Update Calls
Call#   Using: File#/Name - Field#/Name, Call: File#/Name - Field#/Name
    1:             1 TRANSACT   1 CUSTOMER #        2 CUSTOMER   9 CUSTOMER #
    2:             1 TRANSACT   2 PART NUMBER       3 INVNTORY   1 PART NUMBER

                              PROCEDURE

1  If QUANTITY of (TRANSACT) EQ 0  then . . .
   SKIP
2
   TOTAL PRICE of TRANSACT=QUANTITY of TRANSACT*SELLING EACH of INVNTORY
3
   YEAR-TO-DATE of CUSTOMER=YEAR-TO-DATE of CUSTOMER+TOTAL PRICE of TRANSACT
4
   ON-HAND of INVNTORY=ON-HAND of INVNTORY-QUANTITY of TRANSACT
```

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CIRCLE 154 ON READER SERVICE CARD

the single idea of "activities", computer-like entities that exhibit behaviour when they are sent an appropriate message. There are no nouns and verbs in such a language, only dynamically communicating activities. Every transaction, description and control process is thought of as sending messages to and receiving messages from activities in the system. Moreover, each activity belongs to a family of similar activities, all of which have the ability to recognize and reply to messages directed to them and to perform specific acts such as drawing pictures, making sounds or adding numbers. New families are created by combining and enriching "traits", or properties inherited from existing families.

A message-activity system is inherently parallel: every activity is constantly ready to send and receive messages, so that the host computer is in effect divided into thousands of computers, each with the capabilities of the whole. The message-activity approach therefore enables one to dynamically represent a system at many levels of organization from the atomic to the macroscopic, but with a "skin" of protection at each qualitative level of detail through which negotiative messages must be sent and checked.

This level of complexity can be safely handled because the language severely limits the kinds of interactions between activities, allowing only those that are appropriate, much as a hormone is allowed to interact with only a few specifically responsive target cells. SMALLTALK was the first computer language to be based entirely on the structural concepts of message and activities.

The third and newest framework for high-level communication is the observer language. Although message-activity languages are an advance over the data-procedure framework, the relations among the various activities are somewhat independent and analytic. Many concepts, however, are so richly interwoven that analysis causes them virtually to disappear. For example, 20th century physics assigns equal importance to a phenomenon and its context, since observers with different vantage points perceive the world differently. In an observer language, activities are replaced by "viewpoints" that become attached to one another to form correspondences between concepts. For example, a dog can be viewed abstractly (as an animal), analytically (as being composed of organs, cells and molecules), pragmatically (as a vehicle by a child), allegorically (as a human being in a fairy tale) and contextually (as a bone's way to fertilize a lawn). Observer languages are just now being formulated. They and their successors will be communication vehicles of the 1980's.

My experience, and that of others who teach programming, is that a first computer language's particular style and its main concepts not only have a strong influence on what a new programmer can accomplish but also leave an impression about programming and computers that can last for years. The process of learning to program a computer can impose such a particular point of view that alternative ways of perceiving and solving problems can become extremely frustrating for new programmers to learn.

At the beginning of this study, considerations were given to simulating features of data-procedure languages that children had been able to learn, such as BASIC and LOGO. Then, worried that the imprinting process would prevent stronger ideas from being absorbed, decisions were made to find a way to present the message-activity ideas of SMALLTALK in concrete terms without dilution. This was accomplished by starting with simple situations that embodied a concept and then gradually increasing the complexity of the examples to flesh out the concept to its full generality. Although the communication-like model of SMALLTALK is a rather abstract way to represent descriptions, to the surprise of all, the first group and succeeding groups of children who tried it appeared to find the ideas as easy to learn as those of the more concrete languages.

For example, most programming languages can deal with only one thing at a time, so that it is difficult to represent with them even such simple situations as children in a school, spacecraft in the sky or bouncing balls in free space. In SMALLTALK parallel models are dealt with from the start, and the children seem to have little difficulty in handling them. Actually, parallel processing is remarkably similar to the way people think. When you are walking along a street, one part of your brain may be thinking about the route you are taking, another part may be thinking about the dinner you are going to eat, a third part may be admiring the sunset, and so forth.

Another important characteristic of SMALLTALK is the classification of objects into families that are generalizations of their properties. Children readily see themselves as members of the family "kids", since they have common traits such as language, interests and physical appearance. Each individual is both a member of the family kids and has his or her own meaning for the shared traits. For example, all kids have the trait eye colour, but Sam's eyes are blue and Michele's are brown. SMALLTALK is built out of such families. Number symbols, such as 2 or 17, are instances of the family "number". The members of this family differ only in their numerical value (which is their sole property) and share a common definition of the different messages they can receive and send. The symbol of a "brush" in SMALLTALK is also a family. All the brush symbols have the ability to draw lines, but each symbol has its own knowledge of its orientation and where it is located in the drawing area.

The description of a programming language is generally given in terms of its grammar: the meaning each grammatical construction is supposed to convey and the method used to obtain the meaning. For example, various programming languages employ grammatical constructions such as (PLUS 3 4) or 3 ENTER 4+ to specify the intent to add the number 3 to the number 4. The meaning of these phrases is the same. In the computer each should give rise to the number 7, although the actual methods followed in obtaining the answer can differ considerably from one type of computer to the next.

The grammar of SMALLTALK is simple and fixed. Each phrase is a message to an activity. A description of the desired activity is followed by a message that selects a trait of the activity to be performed. The designated activity will decide whether it wants to accept the message (it usually does) and at some later time will act on the message. There may be many concurrent messages pending for an activity, even for the same trait. The sender of the message may decide to wait for a reply or not to wait. Usually it waits, but it may decide to perform other functions if the message has invoked a method that requires considerable computation.

The integration of programming – language concepts with concepts of editing, graphics and information retrieval makes available a wide range of useful activities that the user can invoke with little or no knowledge of programming. Learners are introduced to SMALLTALK by getting them to send messages to already existing families of activities, such as the family "box", whose members show themselves on the screen as squares. A box can individually change its size, location, rotation and shape. After some experience with sending messages to cause effects on the display screen the learner may take a look at the definition of the box family. Each family in SMALLTALK is described with a dictionary of traits, which are defined in terms of a method to be carried out. For example, the message phrase "joe grow 50" says: Find the activity named "joe", find its general trait called "grow____" and fill in its open part with the specific value 50. A new trait analogous to those already present in the family definition (such as "grow" or "turn") can easily be added by the learner. The next phase of learning involves elaboration of this basic theme by creating games such as space war and tools for drawing and painting.

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CIRCLE 163 ON READER SERVICE CARD

Personal Computer, cont'd...

There are two basic approaches to personal computing. The first one, which is analogous to musical improvisation, is exploratory: effects are caused in order to see what they are like and errors are tracked down, understood and fixed. The second, which resembles musical composition, calls for a great deal more planning, generality and structure. The same language is used for both methods but the framework is quite different.

Experience has shown that there should be a balance between free exploration and a developed curriculum. The personal computing experience is similar to the introduction of a piano into a third grade classroom. The children will make noise and even music by experimentation, but eventually they will need help in dealing with the instrument in non-obvious ways. For children the various levels of abstraction supplied by SMALLTALK are not equally accessible. The central idea of symbolization is to give a simple name to a complex collection of ideas, and then later to be able to invoke the ideas through the name. Children between the ages of six and seven have been able to take this step in their computer programs, but their ability to look ahead, to visualize the consequence of actions they might take, is limited.

Children aged eight to 10 have a gradually developing ability to visualize and plan and are able to use the concept of families and a subtler form of naming: the use of traits such as size, which can stand for different numerical values at different times. For most children, however, the real implications of further symbolic generality are not at all obvious. By age 11 or 12 there exists a considerable improvement in a child's ability to plan general structures and to devise comprehensive computer tools. Adults advance through the stages more quickly than children, and usually they create tools after a few weeks of practice. It is not known whether the stages of intellectual development observed in children are absolutely or only relatively correlated with age, but it is possible that exposure to a realm in which symbolic creation is rewarded by illuminating and interesting effects could reduce the time required for children to mature from one stage to the next.

The most important limitation on personal computing for non-experts appears when they conceive of a project that, although it is easy to do in the language, calls for design concepts they have not yet absorbed. For example, it is easy to build a span with bricks if one knows the concept of the arch, but otherwise it is difficult or impossible. Clearly as complexity increases, "architecture" dominates "material". The need for ways to characterize and communicate architectural concepts in developing programs has been a long-standing problem in the design of computing systems. A programming language provides a context for developing strategies, and it must supply both the ability to make tools and a style suggesting useful approaches that will bring concepts to life.

It is quite evident that personal computers will become an integral part of people's lives in the 1980's. The editing, saving and sifting of all manner of information will be of value to virtually everyone. More sophisticated forms of computing, however, may be analogous to music in that most people will come to know of them and enjoy them but only a few will actually become directly involved.

How will personal computers affect society? The interaction of society and a new medium of communication and self-expression can be disturbing and cacophonous when most of the society's members learn to use the medium routinely. The social and personal effects of the new medium are subtle and difficult for the society and the individual to perceive. To use writing as a metaphor, there are three reactions to the introduction of a new medium: illiteracy, literacy and artistic creation. After reading material became available the illiterate were those who were left behind by the new medium. It was inevitable that a few creative individuals would use the written word to express inner thoughts and ideas. The most profound changes were brought about to the literate. They did not necessarily become better people or better members of society, but they came to view the world in a way quite different from the way they had viewed it before, with consequences that were difficult to predict or control.

We may expect that the changes resulting from computer literacy will be as far-reaching as those that came from literacy in reading and writing, but for most people the changes will be subtle and not necessarily in the direction of their idealized expectations. For example, we should not predict or expect that the personal computer will foster a new revolution in education just because it could. Every new communication medium of this century – the telehone, the motion picture, radio and television – has elicited similar predictions that did not come to pass. Millions of the uneducated people in the world have ready access to the accumulated culture of the centuries in public libraries, but they do not avail themselves of it. Once an individual or a society decides that education *is* essential, however, the book, and now the personal computer, can be among the society's main vehicles for the transmission of knowledge.

The social impact of simulation – the central property of computing – must also be considered. First, as with language, the computer user has a strong motivation to emphasize the similarity between simulation and experience and to ignore the great distances that symbols interpose between models and the real world. Feelings of power and a narcissistic fascination with the image of oneself reflected back from the machine are common. Additional tendencies are to employ the computer trivially (simulating what paper, paints and file cabinets can do), as a crutch (using the computer to remember things that we can perfectly well remember ourselves) or as an excuse (blaming the computer for human failings). More serious is the human propensity to place faith in and assign higher powers to an agency that is not completely understood. The fact that many organizations actually base their decisions on – worse, take their decisions from – computer models is profoundly disturbing given the current state of the computer art. Similar feelings about the written word persist to this day: if something is "in black and white", it must somehow be true.

Children who have not yet lost much of their sense of wonder and fun have helped to find an ethic about computing: Do not automate the work you are engaged in, *only the materials.* If you like to draw, do not automate drawing; rather, program your personal computer to give you a new set of paints. If you like to play music, do not build a "player piano"; instead program yourself a new kind of instrument.

A popular misconception about computers is that they are logical or forthright. Since computers can contain arbitrary descriptions, any conceivable collection of rules, consistent or not, can be carried out. Moreover, computers' use of symbols, like the use of symbols in language and mathematics, is sufficiently disconnected from the real world to enable them to create splendid nonsense. Although the hardware of the computer is subject to natural laws (electrons can move through the circuits only in certain physically defined ways), the range of simulations the computer can perform is bounded only by the limit of human imagination. In a computer, spacecraft can be made to travel faster than the speed of light, time to travel in reverse.

It may seem almost sinful to discuss the simulation of nonsense, but only if we want to believe that what we know is correct and complete. History has not been kind to those who subscribe to this view. It is just this realm of apparent nonsense that must be kept open for the developing minds of the future. Although the personal computer can be guided in any direction we choose, the real sin would be to make it act like a machine!

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Noon Introduction to Small Systems for Business, Stan Veit, Associated Computer Industries
Noon Mailing Lists: Several Directions, Dr. Norman I. Agin, Mathtech, Inc.
1 p.m. Selecting a Small Computer for Business, David Benevy, Computer Mart of New Jersey
1 p.m. Evaluating and Improving Your Computer's Performance, Philip Grossman, Raytheon Co.
2 p.m. Law Office Systems Aspects of Word Processing, Bernard Sternin
2 p.m. Future Smart Machines: 2000 A.D. and Beyond, Dr. Earl Joseph, Sperry Univac
3 p.m. Computer Contracts—Facing the issues, Alan C. Verbit, Verbit and Company
3 p.m. Accounts Receivable/Accounts Payable/ General Ledger
4 p.m. Using FORTRAN on a Microcomputer, Richard A. Zeitlin
4 p.m. Investment Analysis of Stocks and Commodities on a Microcomputer, Fred Cohen, Shearson Loeb Rhoades, Inc.

FRIDAY, OCTOBER 31

Noon Introduction to Small Systems for Business, Stan Veit, Associated Computer Industries
Noon BASIC Programming, Michael Mulcahey, Worcester Stage College
1 p.m. Selecting a Small Computer for Business, David Benevy, Computer Mart of New Jersey
1 p.m. Videoprints: Full-Color, Low-Cost, Hard-Copy Computer Graphics, Warren Sullivan, Image Resource Corp.
2 p.m. Mailing Lists: Several Directions, Dr. Norman I. Agin, Mathtech, Inc.
2 p.m. Business Applications Software Development via Data Base Management, Dr. Andrew Whinston, Micro Data Base Systems
3 p.m. Application of PASCAL to Small Systems for Business, Panel, Stan Veit, Moderator, Associated Computer Systems
3 p.m. Investment Analysis of Stocks and Commodities on a Microcomputer, Fred Cohen, Shearson Loeb Rhoades, Inc.
4 p.m. Advantages of Distributed Processing and Multi-Processing, John Steefel, Q1 Corp.
4 p.m. To be assigned.

SATURDAY, NOVEMBER 1

Noon Educational Software: The Good, the Bad, the Ugly. Jo Ann Comito, S.U.N.Y. at Stony Brook
Noon Introduction to Personal Computing, RCA—Solid State
1 p.m. Computer-Assisted Mathematics Courses, Dr. Frank Scalzo, Queensborough Community College
2 p.m. Artificial Intelligence Update, Prof. Peter Kugel, Boston College
2 p.m. Compiling and Retrieving Personal Medical Data, Dr. Derek Enlander, St. Luke's Hospital
2 p.m. The Present State of CP/M Compatible Software, Tony Gold, Lifeboat Associates
3 p.m. High Volume Data Handling: An Introduction to File Processing, Prof. Peter Kugel, Boston College
3 p.m. Connecting the Computer to the Outside World, Prof. James Gips, Boston College
4 p.m. Educational Applications in the Home, David Ahl, "Creative Computing Magazine"
4 p.m. Household Applications—Some New, Dr. Dennis J. McGuire

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A View, cont'd...

About three years ago, in a discussion with a budding computerist, I asked what areas of computing were of interest to him. The reply still haunts me — "Oh, I'm interested in computing for computing's sake." Luckily the folks at Rosetta do not share this attitude. Working with their prototype Smalltalk interpreter leads us to believe that there is still hope for people interested in doing useful work with computing machinery. The computing profession's first goal should be to make using computers easier. Why don't we do it for ourselves while we are at it? Smalltalk is a possible movement in that direction.

We must all face the fact that the vast majority of the current hardware that is in use is designed around a sequential execution strategy involving interpretation of bit patterns fetched (usually) one pattern at a time from a storage medium, and acted upon in a step-by-step manner, small steps at that. It is relatively easy for a human to simulate the actions of a machine using pencil and paper. It is a boring task at best and the concepts of the ultimately desired result are often obscure. Consider some higher level language like Basic. Is there really a difference? We still use a step-by-step procedure, the steps are a little bigger.

What Pascal is to the right wing of language development, Smalltalk can be to the anarchist faction.

As processes become more complex, the difference in level becomes irrelevant. What is needed is a method to express often-used concepts, relating to the problem, in a more concise way. GOSUB 1000 as access to a high-level concept does nothing for me.

Enter Smalltalk. Here we get the ability to build a consistent facility for solving problems that fits the needs of the situation. Since the real world usually provides a good source of analogies, consider the example of a manufacturing corporation which needs materials. It would be less than efficient to allow each worker to procure the materials necessary to perform his part of the overall operation. To resolve this situation we, as smart managers, centralize this procurement function in a particular department, let's call it Purchasing. We set up rules for requests for material and mandate how the Purchasing function will respond to these requests. Now individuals or other departments which require materials can get them without being involved in the details by which they were acquired. This would work fine if humans were not involved (have you *ever* gotten what you want?). The concept is valid, however, when we apply it to computing.

The first Actor language to appear for the commercial market might just be that produced by Rosetta, Inc., of Houston, Texas. Recently publicized under the name "Rosetta Smalltalk," it uses a pattern-matching syntax much like Smalltalk 72 and others in the MIT family. It runs on the Z-80 under CP/M, and has a variety of windowing graphic effects especially configured for the Exidy Sorcerer. It requires a fairly full configuration — at least 48K, preferably 56. While definitive marketing plans and pricing have not yet been announced, the Rosetta processor is now in use at a number of test sites, and should be on the market within a few months. A good guess as to price would be $250.

Generalize the idea of a "department" to any concept that does some work (Smalltalk calls these things Objects). [*Note: The term "Actors," meaning the same thing, has been used in our other Actor/Smalltalk articles. The concept is the same. —Ed.*] Each object has rules associated with requests for its work (Smalltalk calls these requests Messages). The object will respond with its answer (Smalltalk calls these answers Responses). By sending messages to objects and routing the replies to other objects, we can build conceptually larger and larger functional objects until sending the right message directly from our keyboard will give us the answer to our question. We can live with the structure required of the messages which we send, since after all we specified the format.

A New Lease on Life for the Sorcerer

The Sorcerer computer is an excellent Z-80 machine that has not caught on as well as it has deserved. Part of the reason is the steep upgrade: while the basic machine (up to 48K) is in a single rugged plastic box with keyboard, the S-100 expansion chassis is another $439, and this was required before you could add a disk drive. Now, however, disk drives that add on directly are available.

Moreover, the Sorcerer package (and its creator, Paul Terrell) has moved from its original maker, Exidy, to the firm of Microsette, which may push it harder.

Meantime, the availability of the Rosetta Actor language could be a real boost, since it adds rather spectacular capabilities to this neat little machine.

The concept is not new. Forth is a building-block language, Fortran coders can define functions and subroutines, most assembly language hackers use macros, and Basic has some building-block functions (unfortunately implementation-dependent). The format used to communicate with these higher-level functions usually appears to be tacked on to the language. Smalltalk implements language format at the most general level of all — everything is an object; all objects have a definable set of messages to which they respond with a definable set of responses; any object can use any other object while doing its thing, including itself. To add to the flexibility — and to the confusion and possible danger — the definition of the messages, responses, and even the method used to determine the response, is usually dynamically modifiable during execution. What Pascal is to the right wing of language development, Smalltalk can be to the anarchist faction. Let us assume that misuse of the power of the language will be minimal.

What does it mean to us? Will it be easier to get solutions to our problems? Is it easier to use? The answer is a firm maybe. Smalltalk allows easy interactive solutions to problems for which the component classes of objects have been defined. As with any solution, someone must develop the basis for the manipulations which lead to the desired result.

Any given implementation of Smalltalk will have a set of pre-defined objects, possibly a library of additional objects and (we hope) an easy way to define new objects and modifying existing objects. If our task is to produce a model of the economy of the Earth, Smalltalk could be a good choice, but we must add additional functions to solve the problem. We must define all the relevant economic objects which will respond to messages (which are responses from other objects — think about it) to the depth and breadth required to accomplish the objective. It may be a while before we can buy these Smalltalk objects from advertisements here in Creative, but there is no reason to believe that this will not happen. Once we have integrated these new objects into our Smalltalk implementation, they appear for all practical purposes to be part of the functionality of the language.

Since a little code may clarify the concept, here is an example. Using Rosetta Smalltalk and CBasic, let's solve a simple problem:

Enter, Sort into ascending order, and Print some number of items.

We will use the same techniques in both programs so that they can be compared directly.

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A View, cont'd...

```
rem Cbasic Solution to Sort Problem

        input "Number of Items";n
        dim a$(n+1)
        for i=1 to n
          input  "Enter Item"; a$(i)
        next i
        c = -1
        while (c)
          c = 0
             for i=1 to n-1
              if a$(i) > a$(i+1)    then \
                 a$(n+1) = a$(i)     :   \
                 a$(i)   = a$(i+1)   :   \
                 a$(i+1) = a$(n+1)  .:   \
                 c = -1
          next i
        wend
        for i=1 to n
          print a$(i)
        next i
        end
```

It may be slow, but it works. No need to get fancy in Basic.

```
"Rosetta Smalltalk Solution to Sort"!
"Set up screen for BIG picture"!
disp hide move to 2 2 grow to 28 62 clear
show.
disp <- "Number of Items".

@n <- read eval.
@a <- List new n+1.
@i <- 0.
do n
   (
  disp <- "Enter Item".
  a[@i <- i + 1] <- read line.).
@c <- yes.
repeat (
   c = no => (done)
   @c <- no.
   @i <- 0.
   repeat (
     (@i <- i + 1)=n => (done)
     a[i]>a[i+1] => (a[n+1] <- a[i].
                     a[i] <- a[i+1].
                     a[i + 1] <- a[n+1].
                     @c <- yes.
                  )
        ).
    ).
@i <- 0.
do n (
     disp <- a[@i <- i + 1].
   ).
done!
```

You must remember that I am an assembler hacker; my nine-year-old daughter can beat my high-level language code. The two programs should function about the same. They even look alike, since it is the same problem.

Now let's define two Smalltalk extensions to help us with this task:

Add the following messages to the class 'List':

. . . input (number) — which reads from the keyboard and fills 'number' elements of the receiver (. . .) List.

. . . sort ascending — which sorts the elements of the receiver into ascending order.

```
"Revised Rosetta Smalltalk Solution to Sort"!
"Set up screen for BIG picture"!
disp hide move to 2 2 grow to 28 62 clear show.
disp <- "Number of Items".
@n <- read eval.
@a <- List new n.
a input n.
a sort ascending.
@i <- 0.
do n (
     disp <- a[@i <- i + 1].
   ).
done!
```

All objects of class "List" now have two useful messages which can be considered language features as far as any reader is concerned. We have extended our version of Smalltalk to include them (although we eliminated the detail of how we did it here). Take one more jump — suppose we then supply a Smalltalk package (with these and other objects, a manual which describes the objects, the messages they answer and their responses) to someone who is more interested in solving problems than writing programs? Could this be the real future of commercial software development?

So much for the blue sky. But all this recursion and interpretation must cost lots in machine cycles, mustn't it?

Answer. This can indeed be true when the method used for the object in question is written in Smalltalk to be run interpretively. (Remember our orientation — the bottom.) But many of the the object methods in Rosetta Smalltalk are written in assembly language. They are called primitive methods and reduce the overhead.

Not only is Smalltalk extensible, but very possibly it is extensible without undue degradation. We can develop our higher-level concepts in Smalltalk, test the results, and then (if necessary) rewrite them in assembly language. (This remains to be seen, since we are still at the prototype stage.)

From our point of view, higher-level computer languages should provide a method of solving some class of problem without the problem-solver worrying about the bits and bytes of the hardware implementation. Smalltalk represents another step in this direction. Coupled with a tailored set of high-speed special-purpose objects, it begins to take on the appearance of a custom language. Smalltalk may be the departure point to 'languages' of the future which would be much too expensive to implement in any other way.

We are not there yet, the search continues: we still need a faster, better and cheaper way to solve the problems we recognized while solving our last problem. Perhaps we always will. ☐

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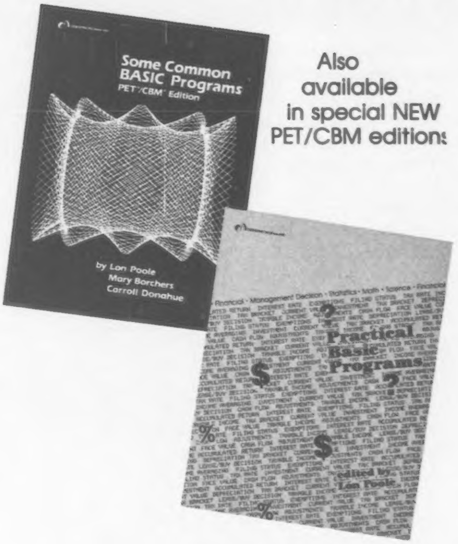

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Extensible, cont'd...

The second, more subtle, and probably more important difficulty is that the sections one may want to (or be able to) break the program into may have nothing to do with the borders between where one wants to use one language and another.

For example, one might want to use Algol-like control structures to handle the flow of control around APL expressions in order to manipulate APL matrices of Pascal records.

In other words, what we want is the ability intimately to mix pieces of all these different languages and have them work together with no confusion.

Another approach often tried is to take a good special-purpose language, and add in enough features that it can do everything else tolerably well. This is why so many Lisps have gotten to be such large unwieldy systems, why Snobol lost much of its elegance, why PL/I and ADA are much too large, and so on and on.

How Languages Are Changed — And Born

Whatever language I use for a new problem, chances are the language doesn't quite fit. Frequently, when I'm programming in any language, certain properties of the language get irritating, either because the language designer's original idea as to what kind of problem his language was to be used for doesn't precisely match what I'm specifically working on, or because his way of going about a problem — his style — isn't mine. In general, when these problems get sufficiently irritating, the original language gets modified, leading to a new dialect, or even a new language. This chafing is probably where most new languages come from, and why there are so many of them.

Indeed, I would be modifying the languages I use all the time, except that the programs which implement the languages (compilers and interpreters) are usually these huge monolithic giants, and they don't lend themselves to casual manipulation. And once the modification is made, much compatibility gets thrown away.

Also, you can't easily modify the language one way for one piece of your code, and another way for another. As long as we're changing languages around, why shouldn't that be allowed?

Language design and redesign should be a part of the process of solving a problem. The ability to extend your language should be one of the facilities which the language itself gives you. To solve a given piece of my problem, I may want to create a new syntax which simplifies the expression of the solution.

This is why Smalltalk is so special. In Smalltalk, each class of objects has its own input syntax. Each class functions as an interpreter for its own syntax; this little interpreter gets run every time an instance of this class receives a message, examining the things to its right. This way, instead of having one huge monolithic program that defines THE LANGUAGE, we have all these little interpreters defining the little languages — the inputs — they are interested in.

This approach is nice and modular, easy to work with, and easy to extend. Instead of learning some big language, when you want to do a certain set of things with a certain set of objects, you simply learn or create the syntaxes of the messages necessary to do these things.

If our solution to the need for multiple syntaxes was simply to allow you to mix syntaxes freely, things would get very confusing. The Smalltalk way of doing it, on the other hand, associates specific syntaxes with specific classes of objects, which, it seems to me, is exactly what you want. In our example of APL-like matrices of Pascal-like records, we would simply have our matrices respond to APL-like syntax while the individual elements of the matrices respond to a Pascal-like syntax.

How do we specify these new syntaxes? How do we build interpreters for them? How free are we to create a syntax, and to what degree are unalterable constraints on our syntax imposed by the system? The Smalltalks represent some rather good answers to these questions. ☐

(See Mark Miller's article on the different Smalltalks, next month.)

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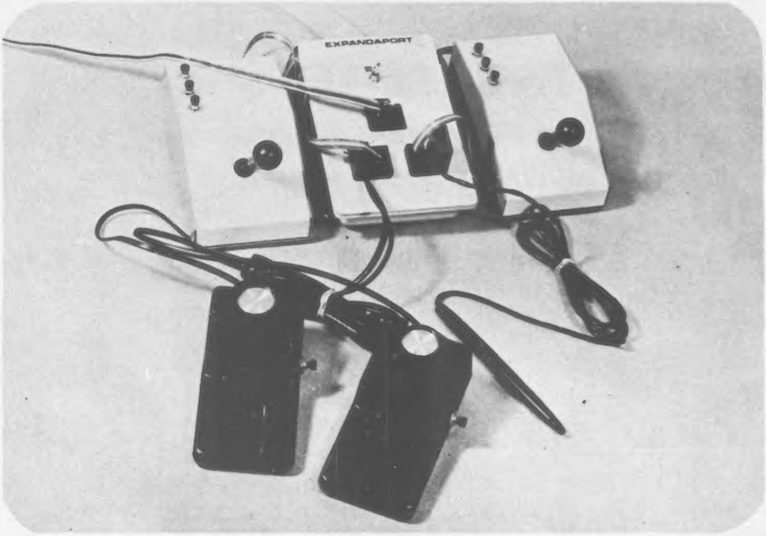

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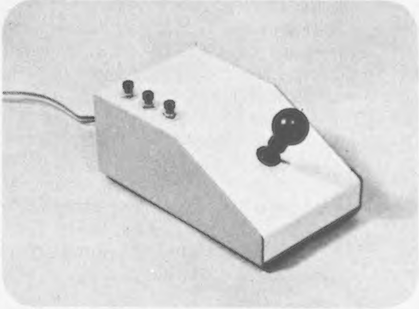

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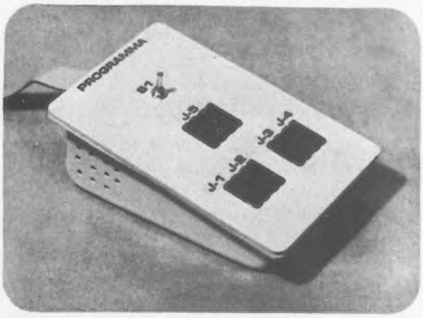

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How Not To Be Out Of Sorts

(Part III: Linked merge sort)

Albert Nijenhuis

The previous two parts of this series have dealt with the insertion sort, a very short program suitable for very short lists only, and heapsort, still a short program, suitable for lists of any length. Neither method requires any working array space, and both move the items around a number of times in the given array space.

As a last method we discuss a version of merge sort. The idea is one of the oldest around, and still is among the most efficient. The version which we discuss takes full advantage of any pre-existing order in the input data. Another plus is that the records to be sorted are not displaced at all, so bulky records or records of varying sizes can be sorted by this method. To achieve all this, we store along with each record one extra word, plus a few additional words of working storage. These words will be referred to as LINKS or POINTERS, respectively.

Linked Lists.

The items of a linked list consist each of two parts, the LINK and the RECORD. A record is a piece of data that needs to be sorted, such as a customer's account, or the text of an address label in a mailing list. The record will contain a KEY, the part on which to sort, such as an account number, a postal (zip) code, or a name to be placed in alphabetical order. The link associated with a record is a single word, and is used in the sorting. It is used in two ways: first, the location of the link should tell the programmer how to find the key in the record (e.g., the fifth word after the link, or the item pointed to by the third item in the directory at the beginning of the record). We shall make no specific assumptions about how the key is obtained, and will simply assume that if the link is stored in location 1, the key is denoted K(1), and K(1) may be anything from the output of a subroutine K to the 1-th member of an array K. (Our Basic program will assume the latter, to avoid unneeded clutter.)

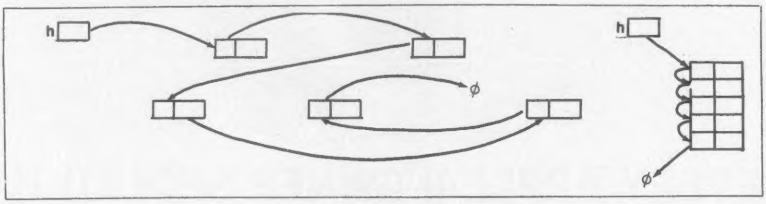

Figure 6. Two linked lists.

As to the content of the link, each link 1 contains the location L(1) of the link of another record, in such a way as to "thread together" all the records. A special HEAD h points to the first link L(h), and the last link point to the "null" link, some symbol that is recognized as not being the location of a link. As we start at the head, passing from link to link, we traverse the whole list. Figure 6 shows two examples of linked lists; Figure 7 shows an example of something that isn't a linked list.

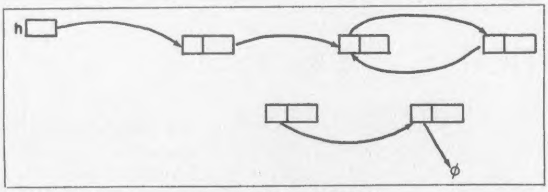

Figure 7. Not a linked list.

Sorting a linked list means shuffling the contents of the links in such a manner that a traversal of the list yields the records in sorted order of keys.

Merge Sorting.

If one has two sorted linked lists, they may be MERGED into one list. Examine the smallest elements of the two lists. Remove the smaller one of these two from its list and place it at the tail of the merged list (initially, the merged list is empty). This process is repeated until one list is empty, at which time the (remaining) other list is appended to the tail of the merged list.

Any linked list, when submitted for sorting, consists of shorter lists that are already sorted. Some of these sublists may be long, while others may have a length as small as 1. However, as long as there is more than one sorted sublist, these sublists may be merged in pairs, and when just one list is left, we are finished.

Note how again (as in Parts I and II) we are dealing with a structure (a family of sorted sublists) which fits the input data and of which the desired result is a special case, while throughout the sorting process we remain within the structure.

As an aside, it is possible to merge

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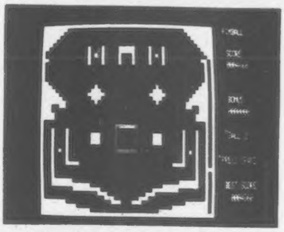

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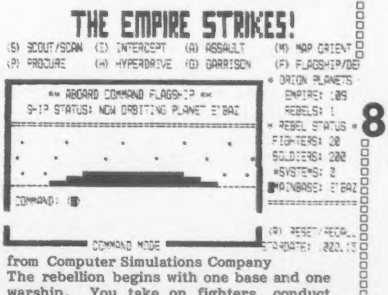

```
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(P) PROCURE     (H) HYPERDRIVE  (G) GARRISON    (F) FLAGSHIP/DE
                                              * ORION PLANETS
      ** ABOARD COMMAND FLAGSHIP **              EMPIRE: 109
   SHIP STATUS: NOW ORBITING PLANET E'BAZ        REBELS: 1
                                              * REBEL STATUS *
                                               FIGHTERS: 20
                                               SOLDIERS: 200
                                               *SYSTEMS: 2
                                              MAINBASE: E'BAZ
 COMMAND:

                                              (R) RESET/RECAL
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You can get a directory or kill files from within SuperScript. TRSDOS or NEWDOS can read SuperScript files. You can insert text into unjustified lines during printout. For example, inserting a name after "Dear" and before the colon. For this purpose a lowercase driver is included.

On printers that can backspace, underlining and slashed zeroes (Ø) are options. On Diablo and NEC printers one can superscript, subscript, underline, boldface and select 10/12 pitch.

The keyboard driver is changed to allow a correct key repeat which is faster than tapping on a key and which does not destroy the video display. The initial character sent to the prnter is changed from a linefeed to a carriage return to empty the buffer. A required space may be specified when it is undesirable to place spaces between parts of text when justifying. From the keyboard you can also enter special characters such as brackets, braces and carets.

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by Gene Bellinger from Acorn

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CIRCLE 175 ON READER SERVICE CARD

Sorts, cont'd...

more than two lists simultaneously, but usually there is little advantage in doing so. However, this is an interesting area of experimentation. (At one time the author has merged as many as 19 lists in one pass!)

In order to find the pre-existing order in a list, we require an algorithm to locate sorted sublists of maximal length. It takes as input a linked list with head h, links L and keys K, and finds the first sorted sublist, which will be output as a linked list with head h' and the "null" link (we use the number 0) as the final link. The length of the sorted sublist is returned in m, and the remaining portion of the input list is again headed by h. The variable t points to the "tail" of the sorted sublist, and is used when new members are attached to the list.

```
ALGORITHM FIND(h,h',m)
m ← 0
h' ← h
DO
   m ← m+1
   t ← h
   h ← L(h)
Repeat while h ≠ 0 and K(t) ≤ K(h)
L(t) ← 0
EXIT
```

The records to be sorted are not displaced at all, so bulky records or records of varying sizes can be sorted by this method.

Test the algorithm on the list in Figure 8! It occupies lines 1370-1480 in the Basic program in Figure 10.

The second essential ingredient in the merge sort is an algorithm which merges two sorted lists, headed by h' and h", into one list headed by h'. If K(h') <= K(h"), the first item of the list headed by h' is moved to the merged list; else we first interchange h' and h". The head of the merged list is temporarily held in L(0) (any other unused location in L will do equally well).

```
ALGORITHM MERGE(h',h")
t ← 0
DO
   If K(h') > K(h") then interchange
         h' ← h"
   L(t) ← h'
   t ← h'
   h' ← L(h')
Repeat while h' ≠ 0
L(t) ← h"
h' ← L(0)
EXIT
```

Test the algorithm on the lists in Figure 9. It occupies lines 1090-1230 in the Basic program in Figure 10.

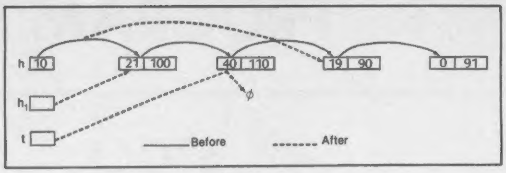

Figure 8.

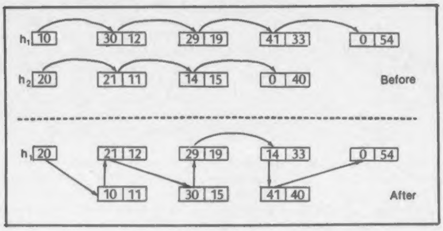

Figure 9.

Merging Strategies.

It is clear that the repeated merging of sorted lists will eventually lead to just one sorted list, which is our aim. The order in which the sorted sublists are merged can have a significant effect on the total required effort. As a rough approximation, the effort involved in merging two lists is proportional to the combined lengths of the lists. The merging of a very long list with a very short one thus accomplishes a little for a lot of work: this type of situation is to be avoided. The more equal in length two candidates for merging, the better off we are. If we did not intend to use the pre-existing order, we could use some rather rigid scheme to minimize the number of comparisons, see, e.g., the "mouse and spider" article by R. Hart in *Creative Computing*, Vol. 4, Issue 1, p. 96. Using the pre-existing order, as we have chosen to do, we are stuck with the initial lengths of the sorted sublists, and have to make the best of it from there on. Our merging strategy will have to depend on these initial lengths, yet to be efficient, will have to be simple. (We don't want to spend all our time computing strategies!)

At this point there are many options. You, the reader, may have some very useful ideas. Please develop them, and TEST them!

Here is the option we have chosen. When at all possible we shall merge two lists only if one is less than twice as long as the other. (This may not always work: suppose that initially there are three sorted sublists, of lengths 1, 10 and 100.) To accomplish this, we have an auxiliary array D, the "directory," which holds head pointers of sorted sublists (or 0 to indicate the absence of a pointer). If a sorted sublist has length 1, its head is stored in D(1), if the length is 2 or 3, we use D(2) to store its head, if the length is between 4 and 7 we use D(3), etc., moving up by a factor 2 for the minimal length each time.

The sorting begins with the search for the first sorted sublist. As it is identified, its length is obtained, and this determines the location in D in which its head is to be stored. The same is done for the next sorted sublist, etc. This continues until (pretty soon, probably) a "collision" occurs: there are two lists whose head pointers belong in the same place, say D(i). When that happens, the conflict is resolved at once: the two lists are merged. We set D(i) to 0 because the length of the new list is now such that its head deserves to be stored in D(i+1). If this location is free, the entry is made; if there is another collision there will be another merging, etc. This process continues until all sorted sublists of the input list have been exhausted.

Merge sort takes full advantage of any pre-existing order in the input data.

At this point there will be a few lists left, whose head pointers are stored in some of the locations in D. We now search D for head pointers, merging as we search. And that finishes the job.

The size of the directory is easily determined: the largest list whose head pointer will ever be entered is that of the full list. Let N be its length: write it to base 2; e.g., if N=1000 we have

1000 (base ten) = 1111101000 (base 2)

and each bit requires a location in D: so in this case 10 locations in D will be required. As a quick, safe guess, dimension D to the number of decimal digits is N times $3\frac{1}{3}$, rounded upward. Although that is generous for N=1000, it is exact for N=999.

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CIRCLE 205 ON READER SERVICE CARD

Sorts, cont'd...

```
1000 'SUBR: MERGE / LINK SORT
1010 'LINKS IN  L  HEADED BY  H
1020 'KEYS IN  K
1030 '
1040 'INITIALIZE DIRECTORY: SIZE D1
1050 FOR I=1 TO D1
1060 LET D(I)=0
1070 NEXT I
1080 '
1090 'MERGING STRATEGY
1100 IF H=0 GOTO 1240   'INPUT LIST EXHAUSTED
1110 GOTO 1370   'NEXT SORTED SUBLIST?
1120 FOR I=1 TO D1
1130 LET M=INT(M/2)
1140 IF M=0 GOTO 1160
1150 NEXT I
1160 IF D(I)<>0 GOTO 1190   'COLLISION
1170 LET D(I)=H1
1180 GOTO 1100   'GET NEXT SORTED SUBLIST
1190 LET H2=D(I)
1200 LET D(I)=0
1210 GOSUB 1490   'MERGE SUBLISTS
1220 LET I=I+1
1230 GOTO 1160   'RE-ATTEMPT INSERTION IN  D
1240 'ALL SORTED SUBLISTS ARE NOW IN  D
1250 FOR I=1 TO D1
1260 IF D(I)<>0 GOTO 1280
1270 NEXT I
1280 LET H1=D(I)
1290 IF I=D1 GOTO 1350
1300 FOR L=I+1 TO D1
1310 LET H2=D(L)
1320 IF H2=0 GOTO 1340
1330 GOSUB 1490   'MERGE SUBLISTS
1340 NEXT L
1350 LET H=H1
1360 RETURN
1370 'FIND NEXT SORTED SUBLIST IN INPUT
1380 LET M=0
1390 LET H1=H
1400 LET T=H
1410 LET M=M+1
1420 LET H=L(H)
1430 IF H=0 GOTO 1120
1440 IF K(T) <= K(H) GOTO 1400
1470 LET L(T)=0
1480 GOTO 1120
1490 'MERGE LISTS HEADED BY  H1  AND  H2
1500 LET T=0
1510 IF K(H1)<=K(H2) GOTO 1550
1520 LET H0=H1
1530 LET H1=H2
1540 LET H2=H0
1550 LET L(T)=H1
1560 LET T=H1
1570 LET H1=L(H1)
1580 IF H1<>0 GOTO 1510
1590 LET L(T)=H2
1600 LET H1=L(0)
1610 RETURN
```

Figure 10.

Merge-Sort.

Here now comes the complete algorithm. To summarize, we are given a linked list of records, with links L, headed by h, and with keys K. The algorithm rearranges the links so the output list, again headed by h, is in sorted order. A directory D, of length d' is required; d' must be no less than the bit length of N, the number of records to be sorted. (One may take d' to be 3⅓ times the number of decimal digits in N, rounded upward.)

The repeated merging of sorted lists will eventually lead to just one sorted list, but the order of merging can have a significant effect on the total required effort.

```
ALGORITHM MERGSORT
For i=1 to d' DO D(i) ← 0 Next i
While h>0 DO
  FIND(h,h',m)
  i ← 0
  While m>0 DO
    i ← i+1
    m ← [m/2]
  Endwhile
  While D(i) ≠ 0 DO
    h" ← D(i)
    D(i) ← 0
    MERGE(h',h")
    i ← i+1
  Endwhile
  D(i) ← h'
Endwhile
i ← min(j such that D(j)>0)
h' ← D(i)
For l = i+1 to d' DO
  h" ← D(l)
  If h">0 then MERGE (h',h")
Next l
h ← h'
EXIT
```

□

"Does that look like a phone booth to you!?" ©Creative Computing

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Speculative Poetics by Peter Payack

CURIOUS COSMOLOGIES

EREWHON (AP) — At the first Convention of Unconventional Cosmologists, these are some of the curious cosmologies that were proffered: 1) The Universe, in its embryonic state, was nothing more than a prize at the bottom of an "archetypal" box of Cracker Jack that in some enigmatic way expanded out of all proportion in size and importance! The paper does not deal with the origin of the "box" itself, nor, for that matter, with what became of the candied popcorn and peanuts and ascribes these mysteries as hopelessly "beyond the scope of human reason." 2) A naturalist was of the opinion that the Cosmos was nothing but "some half-eaten thing a primeval cat dragged in and left on the doorstep of eternity!" The part that was devoured, he postulates, precipitated "Black Holes." 3) A theologian, claiming divine inspiration, posited the stars, galaxies, and quasars of the observable universe were "merely left over table decorations from a prototypal church social held 20 billion years ago"! He reverently insists that the Solar System itself had its origins as a "doorprize" which, he footnotes, went unclaimed. 4) A college fraternity brother proposed that the whole evolutionary development of Space, from the initial "Big Bang" to today's 100 billion galaxies, is the result of some sort of "primordial practical joke that got a little out of hand." "Possibly," he theorized, "this was done at a fraternity hazing where the brothers are always trying to outdo one another." 5) A contingent of High School Sophomores "stochastically guessed" the source of the *Ylem*, the elementary substance from which the universe evolved, was attributable to two possibilities: It was "pulled out of a pail" at a Halloween party where a group of primal teenagers were dunking for apples. Or, it was a "lucky charm" that dropped out of an archaic penny gum machine.

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species
of one,
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The History of the Universe

(as dramatically interpreted by the Dallas Cowboy Cheerleaders)

— a play —

Note: This piece can either be presented as the half-time show of a nationally televised football game, or performed in a theater. For high school productions, it is permissible to use high school cheerleaders.

ACT I The Big Squeeze

(the pre-universal "matter" coagulates into the "Cosmic Egg" or "Ylem")

CHEERLEADERS: "SISSSSSSSSSS-SSSSSSSSSSSSSSSSSSSS . . . "

(The "SISSSSSSS . . . " should be stretched out for as long as possible, in fact, when the curtain is drawn, the "SISSSSSS . . ." should already be in progress, so that the audience knows that it has been going on for a very long, but indeterminate, amount of time. When the curtain opens, the cheerleaders should be in the process of building a "human pyramid." The pyramid should be just about complete, when the first act is over, thus building not only a structure but a sense of expectation.)

ACT II The Big Bang

(the "Cosmic Egg" explodes, and begins to form matter as we now know it)

When the curtain opens, the pyramid of cheerleaders is complete, and then all at once, in unison the cheerleaders yell:

CHEERLEADERS: "B-O-O-O-O-O-O-O-O-O-O-O-O-O-O-O-O-O-O-O-O-M . . "

(This "B-O-O-O-O-M . . " should last approximately 3 minutes, and should be accompanied by wild gesticulations, leaps & bounds, splits, and the throwing of pom poms and confetti into the audience.)

Act III The Cool Down

(the universe begins to cool down, aggregate, and form into galaxies, stars, & planets)

CHEERLEADERS: "BAHHHHHHHH-HHHHHHHHHHHHHHHHHH . . . "

(This "BAHHHHHH . . . " should be accompanied with cartwheels, cheers, with elaborate patterns, and intricate and complicated coreographed routines. Ideally, the third act should last 15 billion years, at a minimum. However, since the attention span of the audience might be somewhat shorter, it can be abbreviated and shortened to last about an hour.)

While the universe is cooling down, if performed inside, the air conditioning unit in the theater should be activated, to actually "cool down" the place, while the lights should be gradually dimmed.

Just before the ultimate curtain of darkness falls, a comet should streak by, with a banner with the words "The End?" attached to its tail.

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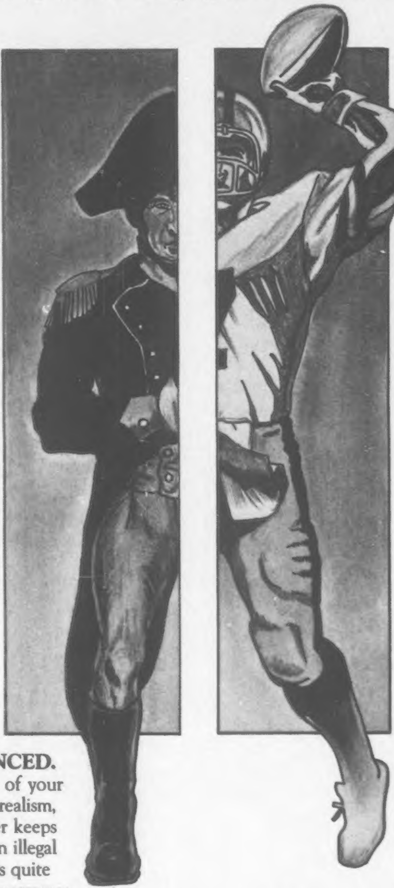

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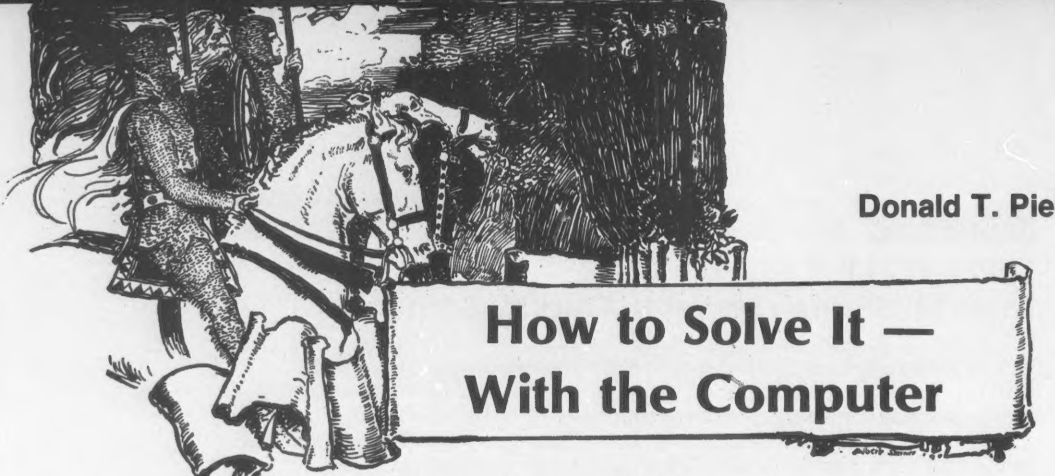
CIRCLE 162 ON READER SERVICE CARD



Donald T. Piele

How to Solve It — With the Computer

Part II

> *"Perhaps the most significant discovery generated by the advent of computers will turn out to be that algorithms, as objects of study, are extraordinarily rich in interesting properties; and furthermore that an algorithmic point of view is a useful way to organize knowledge in general."*
>
> *Donald Knuth, 1974*

Recently, I had the opportunity to conduct two summer programming classes for young students. One group was a class of 3rd-6th graders and the other a group of 7th-9th graders (Junior High). The classes ran for two hours each day for two weeks and included access to an Apple II computer and a Hewlett-Packard 2000 minicomputer with 10 terminals. A few of the students had previous experience with Basic programming but most were new to the subject.

Finding appropriate published classroom materials was difficult. Most textbooks on the Basic language deal primarily with the *content* of the language, but my major objective was to emphasize the *process* by which the language is used to express algorithms that solve problems. In this context the Basic language becomes a vehicle for the development of problem-solving skills rather than an object of study in its own right. To carry out this objective, I had to develop my own classroom activities.

Classroom Procedures

I began on the first day as follows.

1. Each student was given a manila folder to hold all of the classroom notes and computer printouts. It was returned each day to the classroom file. The objective was to establish the habit of keeping good records.
2. The first half hour of each day was devoted to the introduction of new Basic commands and statements that would be necessary to solve the daily problem. The students took notes from the blackboard. It is important to require that students become responsible for recording the information they will need for reference later on.
3. The next hour was spent at the terminals where the students worked in pairs. I wanted to encourage the sharing of ideas as much as possible.
4. A completed assignment consisted of a listing and run of the program including the student's name, and lesson number.
5. The last half-hour was used for a classroom demonstration of individual solutions or for class participation in a computer word or strategy game.

This format created a busy environment in which I functioned as an advisor and trouble shooter and they functioned as teams of problem solvers. In the process of working on the assignment, each team made observations, organized information, looked for patterns, made conjectures and tried them out, and used symbols to express their ideas in algorithmic form. These are precisely the skills I wanted to develop.

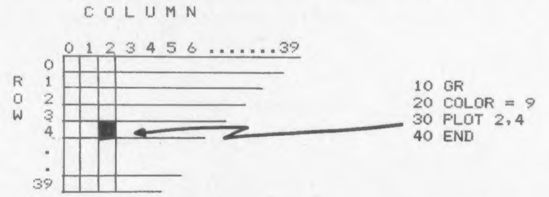
The student solutions tended to be very similar in the beginning. When the problems became more challenging later on, however, the programs began to represent a greater variety of strategies.

Programming Activities

The following programming activities consist of problems used in two courses described above. They include graphics problems on the Apple II for the beginning students and an investigation of algorithms for generating various sequences of numbers in a geometric design for intermediate and advanced students.

Lesson #2 (Beginning Students) Apple Graphics

In the first lesson (last month), I began with a simple program, (listed below), that used the GR, COLOR, PLOT A,B and END commands. This program illustrates how to color any position on the 40x40 low-resolution graphics screen.



```
10 GR
20 COLOR = 9
30 PLOT 2,4
40 END
```

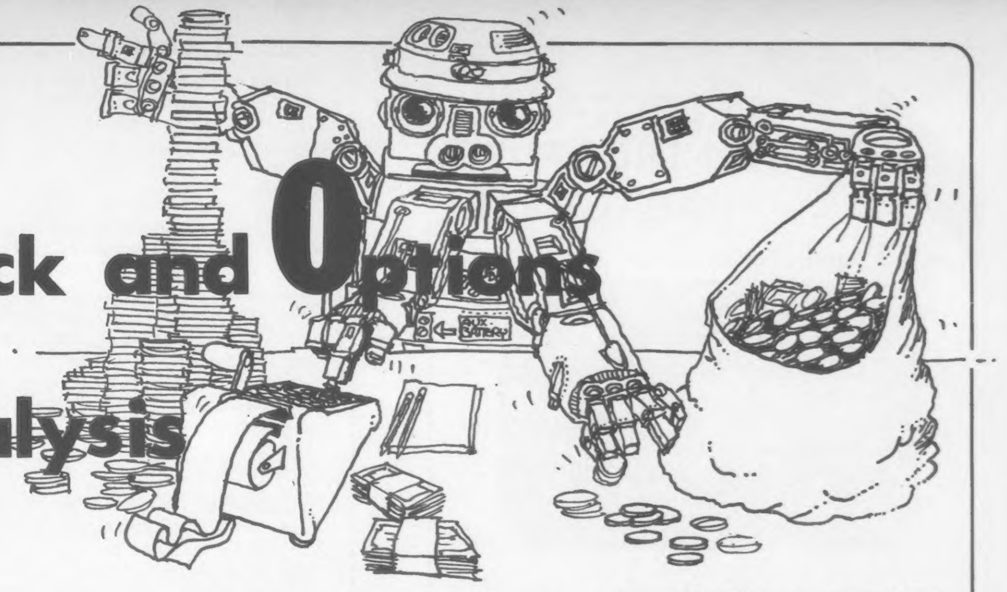
When I introduced this program I made up copies of a 40x40 array with labels across the top and side, as above, and passed them out to the class. This makes it easier for students to write graphics programs at their desk. To review the coordinate system in low-resolution graphics, I used the following program and asked the class to create a small design by supplying a series of values for the COLOR and the position A,B.

```
10 GR
20 INPUT "COLOR = ",C
30 INPUT "PLOT A,B = ";A,B
40 COLOR=C
50 PLOT A,B
60 GOTO 20
70 END
```

After the students completely understood the effect of PLOT A,B, I introduced the following problem.

Donald Piele, University of Wisconsin-Parkside, Kenosha, WI 53141.

Stock and Options Analysis



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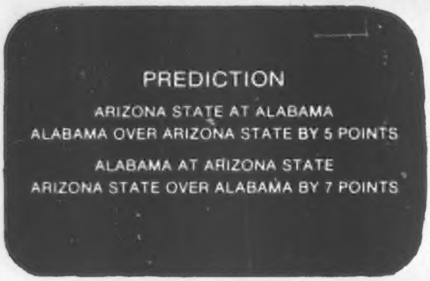

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CIRCLE 101 ON READER SERVICE CARD

Solve It, cont'd. . .

Problem #2 (Beginning Student with Apple II)
Write a program that will color the positions 3,3 and 12,14 orange and will draw the shortest green path between them. (A path is a line of color with no breaks).

Remarks

1. For beginning students, the program will simply be a series of PLOT X,Y statements that connect the two points.
2. The length of the path is equal to the number of positions plotted.
3. There is more than one "shortest" path in this problem.
4. Students who have used FOR-NEXT loops may use them to write a much shorter program.
5. For intermediate students you can upgrade the problem to: Write a program that will draw a shortest path between any two points A,B and C,D.

Print Graphics

For a computer system that has no special graphics mode, a limited form of graphics can be done with print statements. The idea hers is to use the position of the line number in the program to determine the row position and to use the position of a character in the PRINT statement to determine the column position. Beginning students are learning a lot of new procedures, so I like to use simple graphics problems that use only one statement — PRINT. For example, consider the following program that prints a block M.

```
 10 PRINT "MMMM        MMMM"
 20 PRINT "MMMMM      MMMMM"
 30 PRINT "MMMMMM    MMMMMM"
 40 PRINT "MMM MMM  MMM MMM"
 50 PRINT "MMM  MMMMMM  MMM"
 60 PRINT "MMM   MMMM   MMM"
 70 PRINT "MMM    MM    MMM"
 80 PRINT "MMM          MMM"
 90 PRINT "MMM          MMM"
100 END
```

There are a number of ways to pose problems that use simple line by line print graphics. For example, consider:

Problem #2 (Beginning Students)
Write a program using only print statements that will print the next term in the sequence of triangular designs:

```
1,      3 3,     6 6 6       A A A A   ......
         3        6 6         A A A
                   6           A A
                                A
```

For numbers>9 use the alphabetic code A=10, B=11, . . . Z=35.

This type of problem is one step beyond the simple printing of a design since the pattern must first be deduced. What is the next term in the sequence 1,3,6,10, ? . What is its letter equivalent? How do you make the design with print statement? These are mini-problems that must be answered in the process of solving the original problem.

Remarks

1. The next number is of course 15 which corresponds to F.
2. A typical solution is

```
10 PRINT "   F F F F F"
20 PRINT "    F F F F"
30 PRINT "     F F F "
40 PRINT "      F F"
50 PRINT "       F"
60 END
```

This problem becomes much more interesting when it is generalized for intermediate students.

Intermediate Students

Students who know how to use the TAB( ) statement and are comfortable with FOR-NEXT loops should be invited to solve

Problem #2 (Intermediate Students)

Write a program that will generate any term in the geometrical triangular sequence:

```
1,    3 3,    6 6 6,    A A A A  ....
       3       6 6       A A A
                6         A A
                           A
```

In going from the very concrete to the general we have made a quantum leap in the level of difficulty. But in the process, we have found a problem that requires the careful use of subgoals. The subgoals are:

1. Write an algorithm that will generate the Kth term of the triangular sequence.
2. Pass the value of this term to a procedure that will print the geometric design.

Subgoals

1. The Kth term of the triangular sequence,

```
INDEX    1    2    3    4    5........K
      ---*----*----*----*----*....*----*
 TERM    1    3    6    10   15 ......X
```

can be generated by observing that the difference between successive terms increases by 1. An algorithm that generates the value X of the Kth term of the triangular sequence is

```
30 INPUT " INDEX = ";K
40 X=0
50 FOR I = 1 TO K
60     X = X + I
70 NEXT I
```

2. The resulting value of X must now be transformed into a digit or letter from the string
A$=123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ".
In North Star Basic and Xth number in this string is denoted by A$(X,X). In Microsoft Basic it is denoted by MID$(A$,X,1).

3. Finally, a plan of attack is needed to create the actual design.

Plan of Attack

"Begin printing K symbols in the first row with a space between each symbol. Skip down one line, tab over one position and print one less symbol than in the previous line. Continue until all K rows have been printed."

A basic program that implements this plan is the following:

```
Sample Solution:
  5 REM PROBLEM#2 (Intermediate Students) Sample Solution
 10 DIM A$(35)
 20 A$="123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ"
 30 INPUT " INDEX = ";K
 35 REM *** GENERATE  K TH TERM ***
 40 X=0
 50 FOR I = 1 TO K
 60     X = X + I
 70 NEXT I
 75 REM *** GENERATE THE DESIGN ***
 80 FOR I = 1 TO K
 90    TAB(I),
100        FOR J = 1 TO K+1-I
110           PRINT A$(X,X);" ",
120        NEXT J
130    PRINT
140 NEXT I
150 END
```

Remarks

1. Line 110 will need to be replaced with MID$(A$,X,1) in Microsoft Basic.

2. As it stands now, when you try to print the 8th term (36) or higher you will get an out of bounds error.

3. One way to keep things in bounds for large values of X is to reduce X by subtracting out all multiples of 35, i.e., (X MOD 35). The idea is equivalent to starting over at 1 when you reach 36, much like a clock that starts again at 1 after passing 12.

4. When students discover that they cannot go beyond the 7th term, it is time to suggest that they look for a way to wrap the numbers around a 36 hour clock. One way to do this is to

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Solve it, cont'd. . .

add the lines

```
77 X = X - 35*INT(X/35)
78 IF X = 0 THEN X = 35
```

5. This additional requirement can be a bit sticky for those who are not familiar with clock arithmetic. There is a good chance that a number of students will need to do some experimenting on this problem alone. This could be viewed as an additional subgoal.

Advanced Students

For the advanced student the problem takes on added dimensions. They are given a different sequence of numbers and asked to generate the geometrical design of any term with the proper symbol, using a value which had been reduced modulo 35.

Problem #2 (Advanced Students)
Write a program that will represent any term in the sequence

```
INDEX     1     2      3       4       5
      ----*-----*------*-------*-------*------
TERM      1     5     12      22      35 ....
```

graphically. Use symbols from the string

A$="123456789ABC. . .Z"

to construct the figure and reduce all terms mod 35.

The added challenge to this problem is to find the geometrical design for this sequence and to write an algorithm to construct it. The difference between successive terms is different in this problem and increases by 3 instead of 1. Thus the next term is 35 + 16 or 51.

One way to view this sequence geometrically is

```
1 ,   5 5 ,  C C C ,   M M M M,
      5 5    C C C     M M M M
       5     C C C     M M M M
              C C       M M M
               C         M M
                          M
```

This suggests another way to view the sequence of numbers: each design has a square top and a triangular bottom.

```
C C C
C C C    = 3 x 3, (The third Square number.)
C C C
- - -
 C C     = 3,     (The second Triangular number.)
  C
```

Thus, this Pentagonal sequence can be viewed as the sum of a Square sequence 1,4,9,16 . . . and a Triangular sequence 0,1,3,6 . . . There are two natural algorithms to generate Pentagonal numbers.

```
30 INPUT " INDEX = "; K        30 INPUT " INDEX = ";K
40 X=1                         40 X=0
50 D=1                         50 FOR I=1 TO K-1
60 FOR I =1 TO K-1             60     X=X+I
70     D = D + 3               70 NEXT I
80     X = X + D               80 X = X + K*K
90 NEXT I
```

This leads to the following sample solution:

```
 10 REM PROBLEM #2 (ADVANCED STUDENTS - PENTAGONAL)
 20 DIM A$(35)
 30 A$="123456789ABCDEFGHIJKLMNOPQRSTUVWXYZ"
 40 INPUT "INDEX = ";K
 50 REM *** GENERATE THE Kth TERM ***
 60 X=0
 70 FOR I = 1 TO K-1
 80   X=X+I
 90 NEXT I
100 X = X + K*K
110 REM **** REDUCE THE TERM MOD 35 ****
120 X = X - 35*INT( X/35 )
130 IF X = 0 THEN X = 35
140 REM **** GENERATE THE SQUARE TOP ****
150 FOR I=1 TO K
160   FOR J=1 TO K
170     PRINT A$(X,X);" ";
180   NEXT J
```

```
190   PRINT
200 NEXT I
210 REM **** GENERATE THE TRIANGULAR BOTTOM ***
220 FOR I=1 TO K-1
230   PRINT TAB(I);
240     FOR J=1 TO K-I
250       PRINT A$(X,X);" ";
260     NEXT J
270   PRINT
280 NEXT I
290 END
```

Remark

1. For Microsoft Basic again substitute MID$(A$,X,1) for A$(X,X).

There are many interesting sequences that can be associated with geometric shapes. Students can be asked to discover some of their own and to write the necessary program to display them. Here is one more example:

Problem #2 (Advanced Students — Hexagonal Numbers)
Write a program that will display any term in the sequence 1,6,15,28 . . . graphically using the standard technique for picking the symbol from the string A$.

```
Sample Solution:

The design is

                                  F
                  6              F F
   1,            6 6            F F F ....
                 6 6 ,          F F F
                  6              F F
                                  F
```

The easiest way to view this sequence is by observing that it is nothing more than a Square sequence added to two Triangular sequences.

```
    F
   F F  }     Triangular part
  - - -
  F F F
  F F F  }    Square part
  F F F
  - - -
   F F  }     Triangular part
    F
```

Thus the X value of the Kth term is generated by

```
 50 REM *** GENERATE THE Kth TERM
 60 X=0
 70 FOR I=1 TO K-1
 80   X=X+I
 90 NEXT I
100 X=K*K + 2*X
```

The remaining part of the program is nothing more than drawing the top triangle, the middle square, and finally the bottom triangle.

Strategy Games

Although there is a proper time and place for all types of games, the ones that I have found to be the most useful in the classroom are those that present a problem-solving challenge — better known as strategy games. They work well for me when used in moderation. You might say they have a dessert-like quality — best used at the end of a lesson.

A long time favorite of mine is a simple Nim type game played between two players, called Matches. It can be played with a pile of matches, coins, or even marks on the blackboard. The rules are very simple to understand. Each player takes turns removing 1, 2 or 3 matches from the pile until the pile is reduced to the last match. Whoever must take the last match loses the game. Every player must take something when it is his/her turn and the challenger may decide between playing first or second.

I introduce this game every chance I get to work with a group of young students — who find it fascinating until they figure out the winning strategy. By beginning with small numbers and building up one number at a time, they eventually

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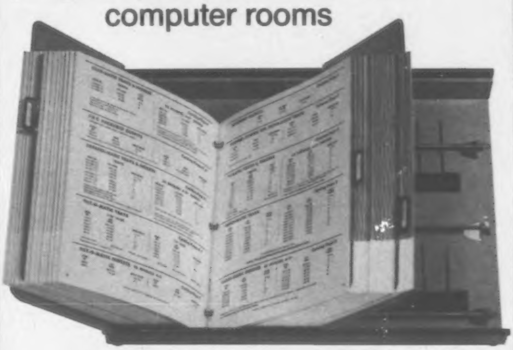

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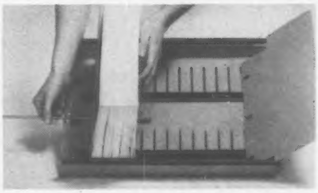

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Solve it, cont'd. . .

discover the strategy themselves. Next, they realize that they can always win with any size pile if they have the option of going first or second. Before the computer was available, I would let the students play at the blackboard where the current champion would give the challenger the option of going first or second. While this usually worked well there was an occasional problem with egos.

This was the first game that I put on the Apple II when it became available three years ago. I have used it in small doses in a variety of classroom settings and I have found it to be my best dessert. It is simple enough that students immediately understand the rules, yet hard enough to keep them coming back for more. To master the game the student must make a leap from the concrete to the general by observing the pattern of losing positions. A further advantage is that the game is over quickly.

A version of this game exists in *101 Basic Computer Games* (David Ahl 1973). Here the number of options are restricted and the status of the pile is printed out after each move on paper. But with the addition of color graphics on the Apple II and the expansion of the program to include a choice for the number of matches (up to 26) and the choice of moving first or second, the game becomes much more useful as an exercise in problem-solving. It is a good example of a strategy game that the whole class can participate in at the end of the day. A typical sixth grade class will probably take a couple of weeks to master it.

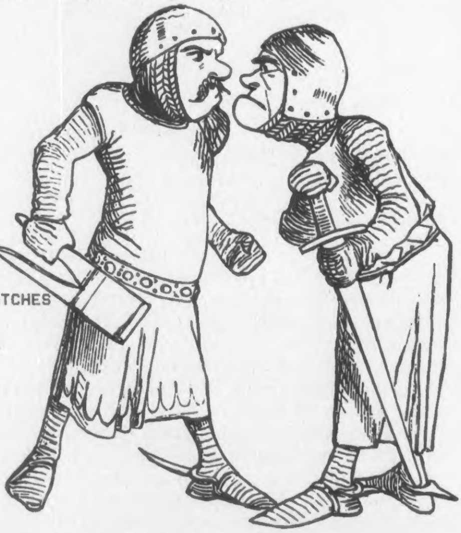
A listing of 26 MATCHES is given below written in Applesoft Basic. It can be entered in Integer Basic — the original version — by deleting the letters INT in lines 430, and 470, and changing line 450 to C = RND(3) + 1. Also, all use of the command HOME should be changed to CALL -936. Finally, change the HTAB 5 in line 180 to TAB 5. □

```
]LIST
100  REM  **************************
110  REM  **  2 6  M A T C H E S  ***
120  REM
130  REM      BY D.T. PIELE
140  REM
150  REM   AN APPLE REVISION OF 23 MTCH
160  REM  101 BASIC COMPUTER GAMES
170  REM  ****************************
180  TEXT : HOME : VTAB 10: HTAB 5
190  PRINT "THIS IS THE GAME OF MATCHES."
200  GOSUB 590: VTAB 12
210  PRINT "IT IS A GAME OF SKILL AND I'M GOOD."
220  GOSUB 590: VTAB 14
230  INPUT "WOULD YOU LIKE INSTRUCTIONS? (Y/N) ";A$
240  IF A$ = "Y" THEN  GOSUB 610
250  PRINT : PRINT "HOW MANY MATCHES DO YOU WANT TO BEGIN"
260  PRINT : INPUT "WITH. PICK A NUMBER UP TO 26. ";M
270  IF M < 1 OR M > 26 THEN 260
280  GR :L = 0:N = M:W = M: IF W > 13 THEN W = 13
290  REM  ***** DRAW MATCHES ******
300  FOR I = 1 TO W: COLOR= 15: VLIN 5,15 AT 3 * I: COLOR= 9: PLOT 3 * I,4
     : NEXT I
310  IF N < 14 THEN 330
320  FOR I = 1 TO N - 13: COLOR= 15: VLIN 20,30 AT 3 * I: COLOR= 9: PLOT 3
      * I,19: NEXT I
330  INPUT "DO YOU WANT TO MOVE FIRST? (Y/N) ";A$
340  IF A$ = "N" THEN 410
350  REM  **** THE HUMAN MOVES ******
360  HOME
370  PRINT "THERE ARE NOW ";M;" MATCHE(S)."
380  PRINT : INPUT "HOW MANY DO YOU WANT TO TAKE?";H
390  IF H > 3 OR H < 1 OR H > M THEN  PRINT "DON'T CHEAT NOW. TRY AGAIN.":
      GOTO 370
400 X = L + H: GOSUB 700:L = X:M = M - H: IF M = 0 THEN 530
410  REM  **** THE COMPUTER MOVES ****
420  IF M = 1 THEN 580
430 R = M - 4 *  INT (M / 4)
440  IF R <  > 1 THEN 470
450 C =  INT (3 *  RND (1)) + 1
460  GOTO 480
470 C = (R + 3) - 4 *  INT ((R + 3) / 4)
480 X = L + C
490  HOME : PRINT "MY TURN, I'M THINKING.": GOSUB 590
500  GOSUB 700:L = X
510 M = M - C: IF M = 0 THEN 580
520  HOME : PRINT "I TOOK ";C;" MATCHE(S)": GOTO 370
530  REM  *** SOMEBODY WON ***
540  HOME : PRINT "I WON!!!!  BETTER LUCK NEXT TIME."
550  PRINT : INPUT "DO YOU WANT TO TRY AGAIN? (Y/N) ";A$
560  IF A$ = "N" THEN  PRINT "THANKS FOR THE GAME ": END
570  TEXT : HOME : VTAB 10: GOTO 250
580  HOME : PRINT "YOU WON!!! NICE GOING.": GOTO 550
590  FOR I = 1 TO 2000: NEXT I: RETURN
600  FOR K = 1 TO 15: NEXT K: RETURN
610  REM  **** INSTRUCTIONS ****
620  HOME : PRINT "WE BEGIN THE GAME WITH A ROW OF MATCHES."
630  GOSUB 590: PRINT
640  PRINT "WE THEN TAKE TURNS REMOVING 1,2 OR 3 ": PRINT : PRINT "MATCHES
      UNTIL THEY ARE ALL GONE."
650  GOSUB 590: PRINT
660  PRINT "WHOEVER TAKES THE LAST MATCHE LOSES!!!": GOSUB 590: PRINT
670  PRINT "YOU MAY MOVE FIRST OR SECOND.": GOSUB 590: PRINT : PRINT
680  PRINT "THE BEST THINKER WILL WIN!!!": GOSUB 590: PRINT
690  RETURN
700  REM  **** REMOVING MATCHES ****
710  COLOR= 0: IF X > 13 THEN 760
720  FOR I = L TO X: FOR J = 1 TO 12
730  PLOT 3 * I,3 + J: GOSUB 600
740  NEXT J: NEXT I
750  RETURN
760  IF L > 13 THEN 790
770  FOR I = L TO 13: FOR J = 1 TO 12: PLOT 3 * I,3 + J: GOSUB 600: NEXT J
     : NEXT I
780  IF L < 13 THEN L = 13
790  FOR I = L - 12 TO X - 13: FOR J = 1 TO 12: PLOT 3 * I,18 + J: GOSUB 6
     00: NEXT J: NEXT I
800  RETURN
```

References

1) Ahl, David H., *Basic Computer Games*, p. 226, Creative Computing Press, Morristown, NJ.

2) Knuth, D.E. "Computer Science and its Relation to Mathematics", *American Mathematical Monthly*, Vol. 81, No. 4, April 1974.



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Some of us wondered who was in charge of the care and feeding of computers.

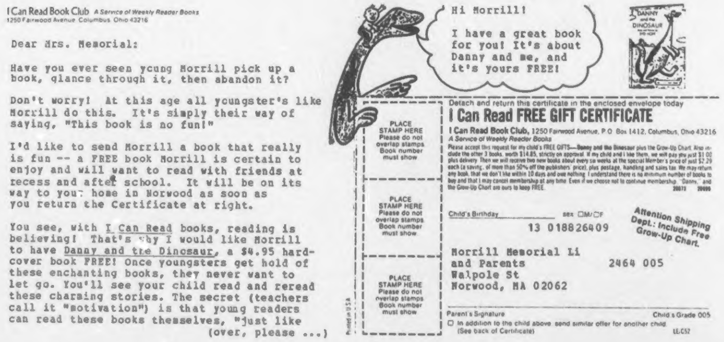
Not too long ago a computerized card arrived at the M.M.L. It was addressed to "Morrill Memorial Li, and Parents, Walpole Street, Norwood Mass." It was from the "I Can Read Book Club," and contained the following message:

This imposing granite building is the home of "Morrill Memorial Library and Parents."

> "Dear Mrs. Memorial, Have you ever seen young Morrill pick up a book, glance through it, then abandon it?"

I hardly think so! The message went on to say that 'Morrill' would receive a free book, etc, etc. So naturally this card prompted a few chuckles among the library staff, and caused some of us to wonder who was in charge of the care and feeding of computers. It was even suggested that the Club's name be changed to "I Can Read, but Can't Think Book Club. ☐

Larry White, 51 Cedar St., Norwood, MA 02062.



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You see, with I Can Read books, reading is believing! That's why I would like Morrill to have Danny and the Dinosaur, a $4.95 hard-cover book FREE! Once youngsters get hold of these enchanting books, they never want to let go. You'll see your child read and reread these charming stories. The secret (teachers call it "motivation") is that young readers can read these books themselves, "just like

(over, please ...)

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Hi Morrill!

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13 018826409

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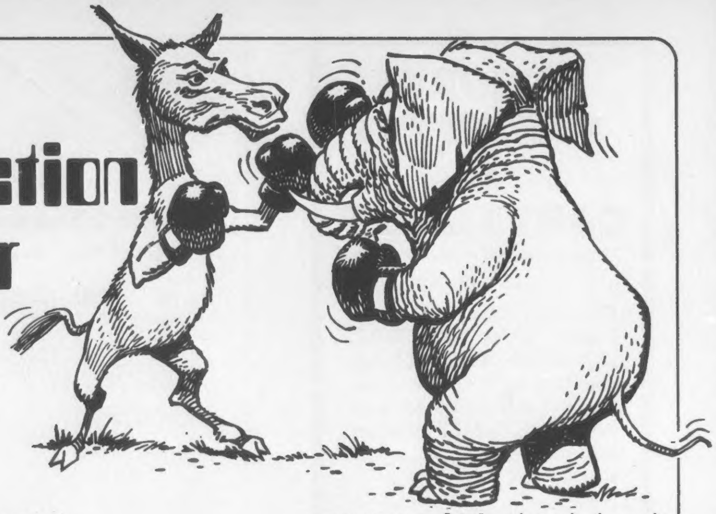
Election Prediction by Computer



Stephen Kimmel

Election night, 6:45 p.m. in America's 45th largest city. The Mayor's friends, relatives, and campaign workers have gathered in a suite at a large hotel to watch the election returns. Nervous conversation fills the air. In the corner, a man with salt and pepper hair is busy setting up a TRS-80 next to the telephone.

7:00 p.m. The polls close. The man with the computer is loading in his program and data file. The mayor's son is moving through the crowd toward the man with the computer.

7:04 p.m. The telephone rings and the man at the computer answers. It is a poll watcher calling in the results from the mayor's home precinct. The man at the computer begins to type in the numbers.

7:05 p.m. The computer displays the results. The mayor will win with approximately 60% of the vote. The celebration begins.

Across town, a younger man duplicates the same events at Party headquarters. The celebration begins except for one small group. The Sewage Commissioner and his family wait silently for additional results to come in. He is the only one predicted to lose tonight.

7:30 p.m. The television station announce during a commercial break that the polls have closed. They invite viewers to stay tuned for the latest election returns. The two computer men have the results from five precincts. Their predictions haven't changed. The Sewage Commissioner leaves to consult with the senior member of the team.

8:00 p.m. The television stations announce the early returns. As usual they are from the part of town that votes heavily for the other party. The entire slate appears to be losing badly. The Sewage Commissioner arrives at the mayor's suite. The senior computer man explains the numbers and their significance.

"You didn't win the areas you were supposed to win."

"Then this is it," the commissioner says.

"Afraid so . . . we did miss one last time," the computer man says. He smiles but the commissioner knows better. He understands. Fifteen years of public office are at an end.

9:00 p.m. The television stations predict the outcome of all of the races except one. It is too close, they say.

This program handles the independent candidate by reducing the expected vote of the major party candidate.

10:00 p.m. During the ten o'clock news, the television stations predict the final race. They agree with the predictions made nearly three hours ago by the two computer men.

Sweet Agony

For me, election nights are a form of sweet agony. I always stay up late watching the results come dribbling in. The networks, especially with statewide races, are always calling the elections "with one percent of the vote reporting, the projected winner is . . . " How can they do that?

On a smaller scale, the two computer men have been doing it for their state for nearly twenty years. In the last sixteen years they have missed just one election. How can they do that?

Actually, it is quite simple.

There are essentially three methods that can be used for election prediction on a small computer. First you can watch key precincts . . . or states. Second, you can use randomly selected precincts. Third, you can use whatever precincts happen to come in and compare them to a projection. This last method is the one used by the two computer men. [*A fourth method, much more expensive, is to obtain detailed demographic breakdowns of the population by ethnic groups, factions and income, then study the way these groups react to the candidates and issues. Then, on election night, watch the districts that clearly represent specific factions and groups — and project those results, which show the groups' final averages, throughout the population in proportion to the relative sizes of the groups. However, you are probably not going to do this on your home computer. — Ed.*]

The key precinct method was probably the first used. You simply wade through several elections and pick out the precincts which consistently reflect the final percentages. Of course, if you are interested in the presidential election you are less interested in the final percent than in the eventual winner. (For example, two key states to watch are Delaware and Missouri. Delaware went with the losing candidate last in 1948, getting seven in a row correct. Missouri has missed just once in the last twelve presidential elections.)

Statistically, the method of random selected precincts is probably the most intellectually satisfying. However, it does require a lot of precincts before any reasonable amount of certainty can be achieved. This can be done with a lot of manpower or a lot of time.

The third method is to base your projections on history. You can use data on how some actual candidate performed in the past, or how some theoretical candidate would have done. This is the technique of this program.

Tweaking the Last Election with the Current Drift

A state's results are reported by the national news services. We use their projections because we would like to have something to work on before a week from next Thursday. The results are compared to our data file to see how the candidate is

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Election, cont'd. . .

doing relative to an earlier candidate. Suppose that CBS projects Carter to win Massachusetts by 62% of the vote. In 1976, Carter just barely won the election and he won Massachusetts with 58% of the vote. Therefore, he is doing better than he did four years ago. Therefore he is likely to win by a larger margin.

Consider the technique as applied to a different state. Suppose Ronald Reagan loses in Georgia but gets 35% of the vote. Carter gets 62% and Anderson and various write-ins get the rest. In 1976, Carter got 67% of the vote. Therefore he is not doing nearly as well as he did four years ago. Therefore the winner will probably be Ronald Reagan.

The analysis works in reverse too. Almost any Republican who can get a third of the vote in Georgia will go on to win. Carter would not be doing as well as expected in his strong area. The question becomes, "If you can't win in your traditional strength areas, where can you win?" That's why it is called the Solid South.

> **Statistically, the method of random selected precincts is probably the most intellectually satisfying. However, it does require a lot of precincts.**

A number of states become indicators of this sort. A Democrat who gets less than 80% of the vote in the District of Columbia is probably doomed to defeat. No Republican who lost Ohio or New Hampshire has ever gone on to win the presidency. No Democrat who lost New York by more than one percent or who lost Maryland or West Virginia has ever won the presidency.

This program contains a synthesized record of a Democratic candidate. It is a mixture of the lower figures from the Carter and the Kennedy races . . . two of the closer rates. I gave slight preference to the Carter numbers since that reflects the more current race. This synthetic Democrat wins with almost exactly 50% of the popular vote and 280 electrical college votes. Two hundred and sixty nine are required to win.

What about Anderson? Or any Independent? George Wallace is the only recent independent candidate to actually win any electoral college votes. In the final analysis these votes were not significant. This program handles the independent candidate by reducing the expected vote of the major party candidate. Practically, this was the major affect of the Wallace candidacy. Because of Wallace, Humphrey didn't get the percentages of the vote needed by a Democrat to win. Personally, I don't expect Anderson to win any states. I'll admit it. This program reflects that bias.

Localizing the Tweak

How do you apply this program to local elections? The first need is your data base. My experience is that any recent election can be used as a data base. I selected this local election for this program because it was easier to work with and because of the added error of dealing with the presidential election. Most elections are contained in a single political entity and the final percentage of the popular vote is all that counts. For local or statewide elections, the precinct-by-precinct registration numbers will usually be sufficient. The variable P in line 350 needs to reflect the percentage of your key party.

Section 460-660 will need to be converted from a state type of input to a simple precinct number approach. With a local election, the variables A and AR are the percent of the popular vote. These are the variables you'll be using to call a local election. Obviously, in a local election everything referencing the Electoral College — in this program any variable with the letter C in it — can be deleted. Essentially, that means lines 750-900 and lines 1030-1350 can be eliminated.

Other Tricks

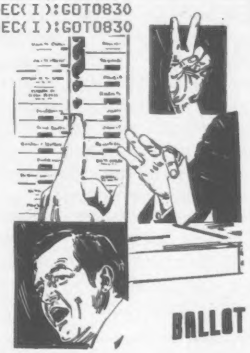
There are two general programming techniques that I used in this program that may be useful. I spell very badly. In section 460-530, the program checks that state name that is input against its list of state names. If the state matches, then control returns to the point where the subroutine is called. If the computer doesn't recognize the name, then it goes through its list of names and prints all of the states that begin with the same letter. Thus if I misspell a state, the computer will ask for it again with the spellings it recognizes on the screen.

The second technique is to ask twice if the operator wishes to quit. This reduces the possibility of an accidental quit (and bombing out of the data).

This year, I expect to watch the election night returns until about eight o'clock. By then I should know whether I'll be celebrating — or wondering what went wrong. □

```
 10 CLS
 20 PRINT"PRESIDENTIAL ELECTION PREDICTION PROGRAM"
 30 PRINT"    WRITTEN IN TRS-80 Lii"
 40 PRINT"    BY STEPHEN KIMMEL"
 50 PRINT:PRINT"     ENTER THE PREDICTED RESULTS FOR THE STATES AS THEY
 60 PRINT"ARE PROJECTED. THE PROJECTED FINAL RESULTS WILL BE DISPLAYED"
 70 PRINT"AFTER EACH STATE IS PROCESSED. THE RESULTS WILL BECOME"
 80 PRINT"MORE ACCURATE AS A LARGER NUMBER OF STATES ARE ENTERED."
 90 PRINT"THREE STATES  ARE  USUALLY SUFFICIENT."
100 PRINT:PRINT"    ON PROJECTION, THE STATES WITH THE STARS ARE STATES
    WHICH"
110 PRINT"THE OTHER PARTY WAS PREDICTED TO WIN."
120 CLEAR 500
130 DIM S$(50),GA(50),EC(50),DA(50),DP(50),TP(50),GP(50),IA(50),TA(50)
140 REM READ IN DATA BASE
150 FOR I=0 TO 50
160 READ S$(I),DP(I),EC(I)
170 GP(I)=100-DP(I):NEXT I
180 DATA CONNECTICUT,47.39,8,DELAWARE,50.82,3,D. OF C.,83.18,3
190 DATA FLORIDA,48.49,17,GEORGIA,62.56,12,MAINE,42.95,4
200 DATA MARYLAND,53.03,10,MASSACHUSETTS,58.11,14,MICHIGAN,51.01,21
210 DATA NEW HAMPSHIRE,44.26,4,NEW JERSEY,48.90,17,NEW YORK,52.02,41
220 DATA NORTH CAROLINA,52.11,13,OHIO,46.72,25,PENNSYLVANIA,51.16,27
230 DATA RHODE ISLAND,55.67,4,SOUTH CAROLINA,51.24,8,VERMONT,41.35,3
240 DATA VIRGINIA,47.25,12,WEST VIRGINIA,52.73,6,ALABAMA,56.67,9
250 DATA ARKANSAS,53.82,6,INDIANA,44.76,13,IOWA,43.25,8
260 DATA ILLINOIS,49.,26,KANSAS,39.28,7,KENTUCKY,53.65,9
270 DATA LOUISIANA,52.96,10,MINNESOTA,50.72,10,MISSISSIPPI,50.97,7
280 DATA MISSOURI,50.26,12,NEBRASKA,37.93,5,NORTH DAKOTA,44.55,3
290 DATA OKLAHOMA,40.98,8,SOUTH DAKOTA,41.79,4,TENNESSEE,56.57,10
300 DATA TEXAS,51.01,26,WISCONSIN,50.86,11,COLORADO,44.06,7
310 DATA NEW MEXICO,48.76,4,UTAH,35.02,4,WYOMING,40.17,3
320 DATA ARIZONA,41.39,6,CALIFORNIA,49.08,45,IDAHO,38.27,4
330 DATA MONTANA,46.22,4,NEVADA,47.73,3,OREGON,47.38,6
340 DATA WASHINGTON,47.98,9,HAWAII,50.03,4,ALASKA,38.11,3
350 FF=1:P=50:F1=1
360 D$="JIMMY CARTER":R$="RONALD REAGAN":I$="JOHN ANDERSON"
370 GOTO980
380 CLS
390 PRINT"ENTER A NUMBER FOR YOUR CHOICE"
400 PRINT"      1-ENTER A REPORTING STATE
410 PRINT"      2-SEE PROJECTIONS
420 PRINT"      3-SEE REPORTING STATES
430 PRINT"      4-QUIT
440 INPUT OP
450 ON OP GOTO 540,1030,1270,1010
460 FOR I=0TO50:IF S$(I)=S$ THEN RETURN
470 NEXT I
480 A$=LEFT$(S$,1)
490 PRINT"I KNOW THE FOLLOWING STATES THAT BEGIN WITH ";A$
```

```
500 FOR I=0TO50
510 IF A$=LEFT$(S$(I),1) THEN PRINT S$(I);" ";
520 NEXT I:PRINT
530 PRINT"PLEASE INPUT THE STATE AGAIN"
540 INPUT"STATE REPORTING";S$
550 GOSUB 460
560 IF DA(I)=0 THEN 620
570 PRINT S$;" HAS REPORTED A DEMOCRATIC PERCENT OF";DA(I)
580 INPUT"IS THIS CORRECT";A$
590 IF A$="YES" OR A$="Y" THEN 540
600 DP=DP-DP(I):DA=DA-DA(I)
610 GP=GP-GP(I):GA=GA-GA(I)
620 PRINTD$;" %";:INPUT DA(I)
630 PRINTR$;" %";:INPUT GA(I)
640 PRINTI$;" %";: INPUT IA(I)
650 IF DA(I)+GA(I)+IA(I)>100 THEN 620
660 IF DA(I)=GA(I) OR DA(I)=IA(I) OR GA(I)=IA(I) THEN 620
670 DP=DP+DP(I):GP=GP+GP(I)
680 DA=DA+DA(I):GA=GA+GA(I)
690 TA=TA+DA(I)+GA(I)
700 TP=TP+DP(I)+GP(I)
710 PP=DP/TP:PR=GP/TP
720 AP=DA/TA:AR=GA/TA
730 A=P*AP/PP:A1=P*AR/PR
740 FF=SQR(AP/PP):F1=SQR(AR/PR)
750 REM PREDICTED ELECTORAL COLLEGE
760 DC=0:RC=0:IC=0
770 FOR I=0TO50
780 IF DA(I)=0 THEN 850
790 REM STATE HAS REPORTED
800 IF DA(I)<GA(I) AND IA(I)<GA(I) THEN RC=RC+EC(I):GOTO830
810 IF DA(I)<IA(I) AND IA(I)>GA(I) THEN IC=IC+EC(I):GOTO830
820 DC=DC+EC(I)
830 NEXT I
840 IF I=51 THEN 910
850 D=DP(I)*FF:G=GP(I)*F1
860 IP=100-D-G
870 IF D>G AND D>IP THEN DC=DC+EC(I)
880 IF G>D AND G>IP THEN RC=RC+EC(I)
890 IF IP>D AND IP>G THEN IC=IC+EC(I)
900 NEXT I
910 REM DISPLAY ROUTINE
920 PRINT" CURRENT PROJECTIONS SHOW ";
930 IF DC>RC THEN PRINT D$;: ELSE PRINT R$;
940 PRINT" THE WINNER"
950 PRINT D$;"......";DC
960 PRINT R$;"......";RC
970 PRINT I$;"......";IC
980 PRINT
990 INPUT"PRESS <ENTER> TO CONTINUE";A$
1000 GOTO 380
1010 INPUT"ARE YOU CERTAIN THAT YOU WANT TO QUIT";A$
1020 IF LEFT$(A$,1)="Y" THEN END ELSE GOTO 380
1030 CLS:REM PROJECTIONS
1040 PRINTD$;" IS PROJECTED TO TAKE THE FOLLOWING STATES":EC=0
1050 FOR I=0 TO 50
1060 IF DA(I)<GA(I) OR DA(I)<IA(I) OR (FF*DP(I)<F1*GP(I) AND DA(I)=0)
     GOTO 1090
1070 IF DP(I)<50 THEN PRINT"*";:ELSE PRINT" ";
1080 PRINTS$(I),:EC=EC+EC(I)
1090 NEXT I:PRINT
1100 PRINT"FOR A TOTAL OF";EC;"ELECTORAL COLLEGE VOTES":EC=0:PRINT
1110 INPUT"HIT <ENTER> TO CONTINUE";Q$
1120 PRINT:PRINTR$;" IS PROJECTED TO TAKE THE FOLLOWING STATES"
1130 FOR I=0TO 50
1140 IF GA(I)<DA(I.) OR GA(I)<IA(I)  OR (F1*GP(I)<FF*DP(I) AND GA(I)=0)
     THEN 1170
1150 IF GP(I)<50 PRINT"*";:ELSE PRINT" ";
1160 PRINTS$(I),:EC=EC+EC(I)
1170 NEXT I:PRINT
1180 PRINT"FOR A TOTAL OF";EC;"ELECTORAL COLLEGE VOTES":EC=0:PRINT
1190 INPUT"HIT <ENTER> TO CONTINUE";Q$
1200 PRINT:PRINTI$;" IS PROJECTED TO TAKE THE FOLLOWING STATES":EC=0
1210 FOR I=0 TO 50
1220 IF IA(I)=<GA(I) OR IA(I)=<DA(I) THEN 1240
1230 PRINT S$(I),:EC=EC+EC(I)
1240 NEXT I:PRINT
1250 PRINT"FOR A TOTAL OF";EC;"ELECTORAL COLLEGE VOTES"
1260 GOTO 980
1270 PRINT"THE FOLLOWING STATES HAVE REPORTED"
1280 FOR I=0TO50
1290 IF DA(I)=0 THEN GOTO 1340
1300 PRINT S$(I);TAB(10);EC(I);" ELECTORAL COLLEGE VOTES FOR ";
1310 IF DA(I)>GA(I) AND DA(I)>IA(I) THEN PRINT D$
1320 IF GA(I)>DA(I) AND GA(I)>IA(I) THEN PRINTR$
1330 IF IA(I)>DA(I) AND IA(I)>GA(I) THEN PRINTI$
1340 NEXT I
1350 GOTO 980
```



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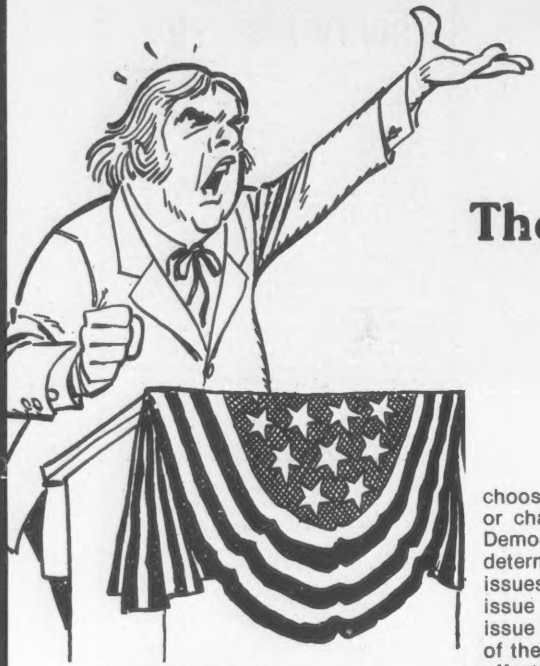

The Presidential Campaign

Ralph G. White

Game Description

The Presidential Campaign allows the user to run for president. The program consumes almost all available memory in a 16K level II TRS-80, so some things could not be included, and there was not enough room to load a line renumbering program.

The states are divided into six groups:

- The New England states
- The upper midwest and middle Atlantic states
- The southern states
- The great plains states
- The southwest states
- The northwest and west coast states

Issues, party affiliation, campaign activities, etc. affect each group of states differently. Some actions have an equal effect on all states. So, when faced with political decisions, sometimes some people will be more pleased than others, and sometimes some actions may be highly unpopular in some areas.

The incumbent initially gets a 10% edge. A routine to determine the popularity of the president then adjusts the figure accordingly. Party affiliation of the user also affects the initial conditions.

Not only does the user get to choose whether to be the incumbent or challenger and whether to be a Democrat or Republican, but also to determine which of six different issues will be the most important issue to their campaign and which issue will be the least important. All of these decisions can influence the effectiveness of your decisions. Which issues are chosen for most important and least important do not affect initial conditions.

The user has nine months in which to campaign. Status in an individual state can be improved by either campaigning in the state or spending campaign money in it. The influence you and your money have in each state varies. The major factor is the number of electoral votes. The number of days campaigning or the amount of money spent is also of importance. It costs $1100 per day to visit each state, some of the days you plan to be in a state can be designated for fund raising as well as campaigning. Fund raising does not help your popularity in a state, but it feeds the campaign treasury. Campaigning increases popularity, but depletes the treasury.

The user gets to choose whether to be the incumbent or challenger and whether to be a Democrat or Republican.

Aside from meeting campaign expenses, the money can be spent in each state to finance campaign committees. The maximum that can be spent in each state at one time is $50,000. You are allowed to visit as many states as time and money allow. You can spend as much money each month as can be afforded.

At the end of each month, you will be given a report on balance of the campaign treasury at the beginning of the month and at the end, the contributions and expenditures for the month, and the results of a political poll which will show your popularity status for a state chosen at random.

Before the beginning of the next month a political event will happen. How the event affects you depends upon the conditions you set forth at the beginning of the program. Some of the events require you to make a decision and the course of action taken influences your status.

At the end you receive a state by state account of the results and how the electoral votes were cast. Who won the electoral votes of each state is displayed, and a running total of the total electoral votes is kept.

Program Information

The Presidential Campaign is written in Radio Shack level II Basic. At least 15K of free memory is needed to run the program.

Following is a table of routines and where they are located in the program:

Title and housekeeping chores	5 - 999
Initial campaign conditions	1000 - 2035
Monthly campaign activities	3000 - 3300
End of month campaign report	4000 - 4999
State by state popularity adjustment	20000 - 21003
Monthly political event	21000 - 21999
Individual state date	30000 - 30510
Scenario	31000 - 31650

□

Ralph G. White, 529 So. Vermont, Columbus, KS 66725

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MISPELL

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All displays show carefully selected spelling words in hi-resolution paragraphs, and ask the learner to replicate the correct spelling as the computer patiently monitors progress. An elaborate operating system supports use by many students in a classroom environment, while separate data diskettes make it affordable to individual home users.

The main program disk contains the Compu-Spell program, operating system, and sample spelling units chosen from each of the six available data diskettes (grade levels 4, 5, 6, 7, 8 and secretarial.) You choose a specific diskette or a coupon exchangeable for one once you have determined a suitable entry level.

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```
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                          S C E N A R I O
   YOU HAVE DECIDED TO RUN FOR PRESIDENT.  AND HAVE OBTAINED
NOMINATION OF YOUR PARTY.  THE CAMPAIGN BEGINS NINE MONTHS
BEFORE THE ELECTION.  YOU HAVE THE OPTIONS OF DECIDING WHICH
STATES TO VISIT EACH MONTH, HOW MANY DAYS YOU WANT TO SPEND IN
THE STATES YOU CHOOSE TO VISIT, AND WHETHER THE VISIT IS FOR
CAMPAIGNING (WHICH WINS POPULAR VOTES), OR FOR FUND RAISING
(WHICH WINS NO POPULAR VOTES, BUT BRINGS IN CONTRIBUTIONS TO
MEET EXPENSES AND FINANCE CAMPAIGN ACTIVITIES IN OTHER STATES).
THE MONEY THAT IS IN THE CAMPAIGN TREASURY CAN BE SPENT AS YOU
WISH IN ANY STATE.
   AT THE BEGINNING OF THE CAMPAIGN, YOU ARE ALLOWED TO MAKE
SOME POLITICAL DECISIONS.  THESE WILL AFFECT THE INITIAL
ATTITUDES OF THE VOTERS WITH RESPECT TO YOU AND YOUR OPPONENT.
THROUGH OUT THE CAMPAIGN, YOU WILL HAVE TO MAKE ADDITIONAL
POLITICAL DECISIONS THAT WILL INFLUENCE VOTER OPINION.  AS
WITH ALL POLITICAL DECISIONS, WHATEVER YOU DECIDE WILL NOT
PLEASE EVERYBODY.  IN ADDITION, SOME OF YOUR DECISIONS WILL BE
COMPARED TO DECISIONS YOU HAVE MADE EARLIER TO DETERMINE YOUR
SINCERITY.  SO WEIGH THE IMPLICATIONS OF EACH DECISION
CAREFULLY.  IN SOME CASES, CHANGING POSITIONS DURING A
CAMPAIGN CAN BE THE BEST STRATEGY, OTHER TIMES IT MAY BE
DISASTROUS.
   AT THE END OF EACH MONTH YOU WILL RECEIVE A REPORT OF THE
FINANCES OF THE CAMPAIGN TREASURY.  YOU WILL BE SHOWN THE
     BALANCE AT THE BEGINNING OF THE MONTH
     BALANCE AT THE END OF THE MONTH
     TOTAL CONTRIBUTIONS DURING THE MONTH
     TOTAL EXPENDITURES DURING THE MONTH
   CAMPAIGNING IS EXPENSIVE, NOT JUST THE MONEY YOU DECIDE TO
SPEND IN STATES, BUT ALSO FOR YOUR ACTUAL CAMPAIGN VISITS TO
THE VARIOUS STATES.  IT IS HELPFUL TO SPEND TIME FUND RAISING
ON VISITS TO OTHER STATES TO MAINTAIN THE CAMPAIGN TREASURY
WITH CONTRIBUTIONS.
   THERE ARE A FEW CAMPAIGN LAWS.
   YOU CAN NOT PUT THE CAMPAIGN TREASURY IN DEBT.
   A $50,000 MAXIMUM IS PLACED ON EACH TRANSACTION.
   UNREPORTED CAMPAIGN CONTRIBUTIONS ARE ILLEGAL.
      (YOU MAY BE TEMPTED TO ACCEPT SOME IF THE TREASURY
      GETS LOW ON FUNDS.  YOU MAY EVEN GET AWAY WITH IT.
      YOU MAY GET AWAY WITH IT MORE THAN ONCE.  HOWEVER,
      YOU MIGHT GET CAUGHT.  IT MAY COST YOU THE ELECTION,
      IT MAY JUST COST YOU A FEW VOTES.)
   YOU CAN CAMPAIGN AS MANY DAYS PER MONTH AS YOU WISH AND
       VISIT AS MANY STATES AS YOU WISH; THE MAXIMUM DAYS
       AVAILABLE EACH MONTH TO CAMPAIGN IS 30.
   AT THE END OF EACH MONTH, YOU WILL BE SHOWN YOUR STATUS
IN ONE STATE--AS OF THE END OF THAT MONTH.  THIS IS THE ONLY
INDICATION YOU WILL RECEIVE ON YOUR PROGRESS.
   AT THE END OF THE CAMPAIGN, THE ELECTION IS HELD AND YOU
WILL RECEIVE A STATE BY STATE ACCOUNTING OF THE RESULTS.
YOU WILL BE SHOWN THE NUMBER OF ELECTORAL VOTES AWARDED BY
EACH STATE, TO WHOM THEY WERE AWARDED, THE TOTAL ELECTORAL
VOTES YOU HAVE RECEIVED AND THE TOTAL ELECTORAL VOTES YOUR
OPPONENT HAS RECEIVED.

1)  BE SURE TO SPELL EACH STATE CORRECTLY.
2)  DO NOT USE A DOLLAR SIGN WHEN ENTERING AMOUNTS OF MONEY.
3)  DO NOT USE A COMMA WHEN ENTERING NUMBERS.


         C O N D I T I O N S

E THE CONDITIONS THAT YOU WISH TO BE TRUE.

IN WHAT YEAR WILL THE ELECTION BE  1979
THAT IS NOT AN ELECTION YEAR
IN WHAT YEAR WILL THE ELECTION BE  1980
WHAT IS YOUR NAME JIMMY CARTER
WHAT IS YOUR OPPONENT'S NAME RONALD REAGAN

'1' TO BE THE INCUMBENT
TYPE '2' TO BE THE CHALLENGER
WHAT IS YOUR CHOICE  1

 '1' TO BE A DEMOCRAT
TYPE '2' TO BE A REPUBLICAN
WHICH POLITICAL PARTY  1

                    I S S U E S

MY CARTER WHICH OF THE FOLLOWING ISSUES:
       (INPUT THE NUMBER, NOT THE PHRASE, PLEASE)
1) UNEMPLOYMENT                4) SOCIAL ADJUSTMENTS
2) INFLATION                   5) DEFENSE
3) ENERGY                      6) FOREIGN AFFAIRS

IS MOST IMPORTANT TO YOUR CAMPAIGN  2
WHICH IS LEAST IMPORTANT TO YOUR CAMPAIGN  4
* * * * * * *     * * * * * * *     * * * * * * *
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FEBRUARY  1980             9  MO. BEFORE ELECTION
YOUR CAMPAIGN FUND HAS      $500,000.00
WHAT STATE DO YOU WISH TO VISIT NEW YORK
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  20
HOW MANY OF THE  20  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  10
DAYS FUND RAISING  10
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO

SPEND CAMPAIGN MONEY IN WHAT STATE CALIFORNIA
YOUR CAMPAIGN FUND HAS      $499,866.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  50000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



            MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                            $500,000.00           $449,866.00
CONTRIBUTIONS =   $21,866.00    EXPENDITURES =   $72,000.00

LLS SHOW YOU ARE AHEAD OF RONALD REAGAN
IN TEXAS.  YOU HAVE  51 % OF THE VOTE.

THE PRESIDENT OF A LARGE UNION PROMISES THE SUPPORT OF THE
UNION'S MEMBERS IF YOU MAKE SOME PRO-UNION CAMPAIGN SPEECHES.
WILL YOU ACCEPT HIS HELP YES
* * * * * * *     * * * * * * *     * * * * * * *

 MARCH  1980               8  MO. BEFORE ELECTION
YOUR CAMPAIGN FUND HAS      $449,866.00
WHAT STATE DO YOU WISH TO VISIT NEW JERSEY
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  15
HOW MANY OF THE  15  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  9
DAYS FUND RAISING  6
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) YES

WHAT STATE DO YOU WISH TO VISIT COLORADO
YOU HAVE  15  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  8
HOW MANY OF THE  8  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  8
DAYS FUND RAISING  0
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


SPEND CAMPAIGN MONEY IN WHAT STATE NEBRASKA
YOUR CAMPAIGN FUND HAS      $430,006.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  20000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



            MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                            $449,866.00           $410,006.00
CONTRIBUTIONS =    $5,440.00    EXPENDITURES =   $45,300.00

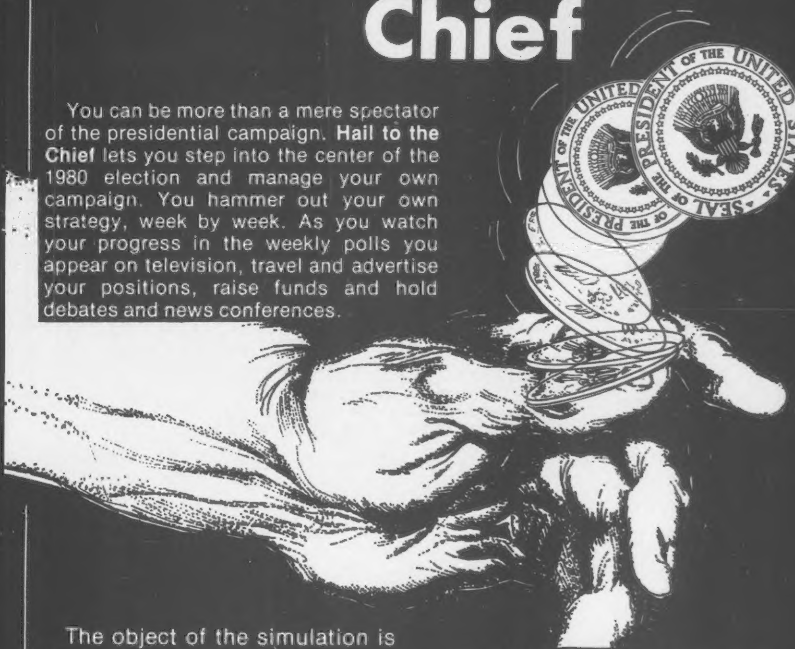
LS SHOW YOU ARE AHEAD OF RONALD REAGAN
IN DELAWARE.  YOU HAVE  70 % OF THE VOTE.

THERE IS A SHORTAGE OF ALL PETROLEUM PRODUCTS--ESPECIALLY
GASOLINE.  THE REASONS FOR THE SHORTAGE ARE UNCLEAR AT THIS
TIME.
* * * * * * *     * * * * * * *     * * * * * * *

DATE: APRIL  1980              7  MO. BEFORE ELECTION
YOUR CAMPAIGN FUND HAS      $410,006.00
WHAT STATE DO YOU WISH TO VISIT OHIO
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  20
HOW MANY OF THE  20  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  21
DAYS FUND RAISING  4
HOW MANY OF THE  20  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  16
DAYS FUND RAISING  4
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


SPEND CAMPAIGN MONEY IN WHAT STATE TEXAS
YOUR CAMPAIGN FUND HAS      $393,339.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
```

Hail to the Chief



You can be more than a mere spectator of the presidential campaign. **Hail to the Chief** lets you step into the center of the 1980 election and manage your own campaign. You hammer out your own strategy, week by week. As you watch your progress in the weekly polls you appear on television, travel and advertise your positions, raise funds and hold debates and news conferences.

The object of the simulation is to become president-elect when the final election results are in. Refinements of the simulation such as the influences of incumbency, campaign finance and spending limits are introduced in increasingly complex models. Each model can be played at ten levels of difficulty—a level 10 opponent is tough to beat.

This is a straightfoward simulation, without scenarios of blatent corruption, but temptations to compromise your ideals are still realistic and powerful...

Will you change your positions to capture the financial support of labor of Big Business? Or play down your unpopular positions to capture the votes of a particularly important and sensitive region? As in real life, the presidency can be captured by integrity or guile. Only the candidate knows the price of his, or her, success.

The ten pivotal campaign issues in **Hail to the Chief** include Energy Policy, Unemployment, Mid-East Policy and Strategic Arms Limitations. Your positions are chosen from a nearly two hundred degree numerical scale which ranges from "Bleeding Heart Liberal" to "Middle-of-the-Road" to "Reactionary". For example, strong conservative and liberal statements on Strategic Arms Limitations are:

Our enemies understand only strength and they have proven that they will not honor any treaty obligation that stands in their path toward world domination.

An uncontrolled arms race is more likely to lead to war then any other policy the U.S. can follow; it is also a waste of our resources and puts too much power in the hands of the military industrial complex.

Hail to the Chief has been used as a teaching aid in Political Science, Computer Science and Voting Behaivior courses at the University level since 1976. Its authors are Associate Professors at the Eastern Kentucky University; Phillip W. Brashaer in Mathematics and Richard G. Vance in Political Science. A comprehensive manual, discussion questions and background materials have been prepared by the authors and accompany the fun and educational package. **Hail to the Chief** is available for the TRS-80 level II on a 32K cassette (CS-3205) and a 48K disk (CS-3701), for the Apple II and Apple II Plus on a 48K disk (CS-4704), for the Atari 400 and 800 on a 32K cassette (CS-7201) and for the Atari 800 on a 40K disk (CS-7701). All are $24.95.

Your local computer store should carry Creative Computing Software. If your favorite retailer does not carry the software you need, have him call in your order to 800-631-8112. Or, you can order directly from Creative Computing. Creative Computing Software, Dep't. AHGG, P.O. Box 789-M, Morristown, NJ 07960. Include $1.00 for postage and handling. For faster service, call in your bank card order toll free to 800-631-8112.

sensational software

CIRCLE 300 ON READER SERVICE CARD

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HOW MUCH DO YOU WISH TO SPEND  50000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



             MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                             $410,006.00             $343,339.00
CONTRIBUTIONS =    $5,333.00     EXPENDITURES =   $72,000.00

S SHOW RONALD REAGAN IS AHEAD OF YOU
IN NEVADA.  HE HAS  55 % OF THE VOTE.

THERE IS A SHORTAGE OF ALL PETROLEUM PRODUCTS--ESPECIALLY
GASOLINE.  THE REASONS FOR THE SHORTAGE ARE UNCLEAR AT THIS
TIME.
* * * * * * *     * * * * * * *     * * * * * * *

DATE: MAY  1980                  6  MO.  BEFORE ELECTION
YOUR CAMPAIGN FUND HAS       $343,339.00
WHAT STATE DO YOU WISH TO VISIT PENNSYLVANIA
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  26
HOW MANY OF THE  26  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING
DAYS CAMPAIGNING  21
DAYS FUND RAISING  5
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


SPEND CAMPAIGN MONEY IN WHAT STATE MONTANA
YOUR CAMPAIGN FUND HAS       $321,939.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  30000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



             MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                             $343,339.00             $291,939.00
CONTRIBUTIONS =    $7,200.00     EXPENDITURES =   $58,600.00

POLLS SHOW YOU ARE AHEAD OF RONALD REAGAN
IN NEBRASKA.  YOU HAVE  58 % OF THE VOTE.

THE PRESIDENT OF A LARGE UNION PROMISES THE SUPPORT OF THE
UNION'S MEMBERS IF YOU MAKE SOME PRO-UNION CAMPAIGN SPEECHES.
WILL YOU ACCEPT HIS HELP YES
* * * * * * *     * * * * * * *     * * * * * * *

 JUNE  1980                 5  MO.  BEFORE ELECTION
YOUR CAMPAIGN FUND HAS       $291,939.00
WHAT STATE DO YOU WISH TO VISIT IOWA
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  15
HOW MANY OF THE  15  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  15
DAYS FUND RAISING  0
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


SPEND CAMPAIGN MONEY IN WHAT STATE ARIZONA
YOUR CAMPAIGN FUND HAS       $275,439.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  40000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



             MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                             $291,939.00             $235,439.00
CONTRIBUTIONS =          $0.00     EXPENDITURES =   $56,500.00

S SHOW YOU ARE AHEAD OF RONALD REAGAN
IN MARYLAND.  YOU HAVE  64 % OF THE VOTE.

A POLITICAL BOSS PROMISES TO CONTRIBUTE  11985  DOLLARS TO YOUR
CAMPAIGN IF YOU WILL APPOINT SOME OF HIS FRIENDS TO POWERFUL
POSITIONS IF YOU WIN.  THIS CONTRIBUTION IS NOT LEGAL.
WILL YOU ACCEPT THE CONTRIBUTIONS (YES/NO) NO
* * * * * * *     * * * * * * *     * * * * * * *

DATE: JULY  1980                 4  MO.  BEFORE ELECTION
YOUR CAMPAIGN FUND HAS       $235,439.00
WHAT STATE DO YOU WISH TO VISIT ALABAMA
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  18
HOW MANY OF THE  18  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  15
DAYS FUND RAISING  3
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


END CAMPAIGN MONEY IN WHAT STATE KANSAS
YOUR CAMPAIGN FUND HAS       $217,079.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  30000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



             MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                             $235,439.00             $187,079.00
CONTRIBUTIONS =    $1,440.00     EXPENDITURES =   $49,800.00

OLLS SHOW YOU ARE AHEAD OF RONALD REAGAN
IN MONTANA.  YOU HAVE  77 % OF THE VOTE.

THE U. S.  IS THE TARGET OF DEMONSTRATIONS IN SEVERAL MIDDLE
EAST COUNTRIES.
SEVERAL EUROPEAN COUNTRIES HAVE ALSO BEEN CRITICAL OF OUR
FOREIGN POLICY.
* * * * * * *     * * * * * * *     * * * * * * *

AUGUST  1980                3  MO.  BEFORE ELECTION
YOUR CAMPAIGN FUND HAS       $187,079.00
WHAT STATE DO YOU WISH TO VISIT KENTUCKY
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  21
HOW MANY OF THE  21  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  19
DAYS FUND RAISING  2
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


SPEND CAMPAIGN MONEY IN WHAT STATE VIRGINIA
YOUR CAMPAIGN FUND HAS       $164,939.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  5500
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



             MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                             $187,079.00             $159,439.00
CONTRIBUTIONS =        $960.00     EXPENDITURES =   $28,600.00

S SHOW YOU ARE AHEAD OF RONALD REAGAN
IN CALIFORNIA.  YOU HAVE  56 % OF THE VOTE.

THE U. S.  IS THE TARGET OF DEMONSTRATIONS IN SEVERAL MIDDLE
EAST COUNTRIES.
SEVERAL EUROPEAN COUNTRIES HAVE ALSO BEEN CRITICAL OF OUR
FOREIGN POLICY.
* * * * * * *     * * * * * * *     * * * * * * *

ATE: SEPTEMBER  1980             2  MO.  BEFORE ELECTION
YOUR CAMPAIGN FUND HAS       $159,439.00
WHAT STATE DO YOU WISH TO VISIT DELAWARE
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  15
HOW MANY OF THE  15  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  12
DAYS FUND RAISING  3
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO

SPEND CAMPAIGN MONEY IN WHAT STATE MINNESOTA
YOUR CAMPAIGN FUND HAS       $143,419.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  50000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) NO



             MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                             $159,439.00              $93,419.00
CONTRIBUTIONS =        $480.00     EXPENDITURES =   $66,500.00

POLLS SHOW YOU ARE AHEAD OF RONALD REAGAN
IN OHIO.  YOU HAVE  73 % OF THE VOTE.

A POLITICAL BOSS PROMISES TO CONTRIBUTE  17359  DOLLARS TO YOUR
CAMPAIGN IF YOU WILL APPOINT SOME OF HIS FRIENDS TO POWERFUL
POSITIONS IF YOU WIN.  THIS CONTRIBUTION IS NOT LEGAL.
WILL YOU ACCEPT THE CONTRIBUTIONS (YES/NO) NO
* * * * * * *     * * * * * * *     * * * * * * *
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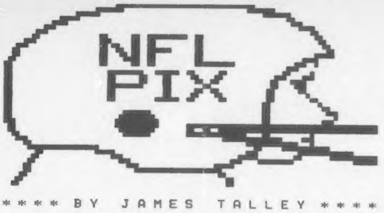

NFL-PIX for 1980-1981 SEASON

* *

Predict this Season's Games!

* *

This program will maintain weekly team schedules, keep track of scores of games played, list current Division win-loss standings and --- predict the probable outcome of games! It establishes a rolling average of strengths of all teams based on past performance. During the last season its prediction was 6% better than the Greek Prognosticator!

For 16K Level II TRS-80 or Single Disk DOS ----- Just $19.95
Please specify tape or disk!! Documentation supplied with either disk or tape.

80 U.S. Software
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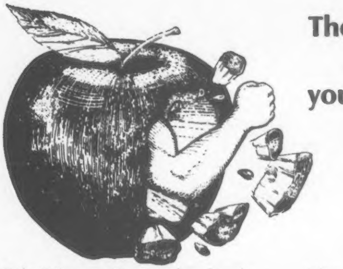
CIRCLE 189 ON READER SERVICE CARD



The Dakin5 12-in-1 Utility Kit gives your programming more punch!

Dakin5 Corporation, a Colorado software house, is making available to the public 12 utility programs on one 16 sector diskette, utilizing the new Apple DOS 3.3, which provides 23% more storage.

All of the Dakin5 Programming Aids 3.3 programs are also compatible with the Corvus Disk Drive system.

Features

- Remove REM statements and compress code to increase program speed and save memory and disk space.
- Copy any file or program from one diskette to another. Only the name is needed.
- Print or display a line cross reference and variable name cross reference.
- Print or display all or selected records from a text file.
- Display any sector of a given file or program, and then update any data within that sector, or specify the sector you wish to update, such as directory sectors and sectors occupied by DOS.
- Create, print and modify your own text and Exec files.
- Copy a diskette without DOS; initialize without DOS; verify source diskette; verify copied data is the same as the original.
- Use a powerful data entry routine that handles both string and numeric data.

Plus Many More Utility Programs for Sophisticated Programmers

Many of these utility programs have been developed and tested for in-house use while producing The Controller™ business package for Apple Computer Inc.

Suggested retail price for Dakin5 Programming Aids 3.3 is $70.00.

Each programming aids package includes a program diskette and very complete documentation, all attractively packaged in a padded, blue print vinyl 3-hole notebook with silver lettering. An identifying tab separates each program for convenient reference.

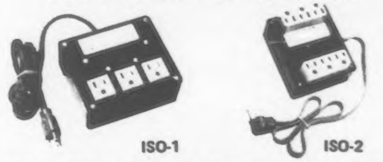
See your Apple dealer or contact Dakin5 Corporation, P. O. Box 21187, Denver, Colorado 80221. Telephone: (303) 426-6090.

DAKIN5
CORPORATION

Apple is a registered trademark of Apple Computer Inc.
The Controller is a registered trademark of Dakin5 Corporation.

CIRCLE 120 ON READER SERVICE CARD

DISK DRIVE WOES? PRINTER INTERACTION?
MEMORY LOSS? ERRATIC OPERATION?
DON'T BLAME THE SOFTWARE!



Power Line Spikes, Surges & Hash could be the culprit!
Floppies, printers, memory & processor often interact!
Our unique ISOLATORS eliminate equipment interaction AND curb damaging Power Line Spikes, Surges and Hash.

*ISOLATOR (ISO-1A) 3 filter isolated 3-prong sockets; integral Surge/Spike Suppression; 1875 W Maximum load, 1 KW load any socket	$56.95
*ISOLATOR (ISO-2) 2 filter isolated 3-prong socket banks; (6 sockets total); integral Spike/Surge Suppression; 1875 W Max load, 1 KW either bank	$56.95
*SUPER ISOLATOR (ISO-3), similar to ISO-1A except double filtering & Suppression	$85.95
*ISOLATOR (ISO-4), similar to ISO-1A except unit has 6 individually filtered sockets	$96.95
*ISOLATOR (ISO-5), similar to ISO-2 except unit has 3 socket banks, 9 sockets total . . .	$79.95
*CIRCUIT BREAKER, any model (add-CB)	Add $ 7.00
*CKT BRKR/SWITCH/PILOT any model (-CBS)	Add $14.00

PHONE ORDERS 1-617-655-1532

ESP Electronic Specialists, Inc.
171 South Main Street, Natick, Mass. 01760
Dept.CC

CIRCLE 142 ON READER SERVICE CARD

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E: OCTOBER  1980            1  MO. BEFORE ELECTION
YOUR CAMPAIGN FUND HAS       $93,419.00
WHAT STATE DO YOU WISH TO VISIT LOUISIANA
YOU HAVE  30  UNSCHEDULED DAYS LEFT THIS MONTH.
HOW MANY DAYS DO YOU WISH TO SPEND THERE  16
HOW MANY OF THE  16  DAYS WILL BE FOR FUND RAISING AND HOW
MANY DAYS WILL BE FOR CAMPAIGNING.
DAYS CAMPAIGNING  16
DAYS FUND RAISING  0
DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) NO


SPEND CAMPAIGN MONEY IN WHAT STATE TEXAS
YOUR CAMPAIGN FUND HAS       $75,819.00
THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000.
HOW MUCH DO YOU WISH TO SPEND  50000
DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO) CALIFORNIA


               MONTHLY REPORT TO THE ELECTION COMMITTEE
CAMPAIGN FUNDS        BEGINNING OF MONTH     END OF MONTH
                            $93,419.00               $25,819.00
CONTRIBUTIONS =         $0.00     EXPENDITURES =   $67,600.00

POLLS SHOW YOU ARE AHEAD OF RONALD REAGAN
IN INDIANA.  YOU HAVE  54 % OF THE VOTE.

THE RATE OF INFLATION HAS DROPPED


<><>  <><>  <><>  <><>  <><>  <><>  <><>  <><>  <><>
                    ELECTION NIGHT RESULTS
                      ELECTORAL VOTES

                                       YOUR       OPPONENT'S
STATE               YOU      OPPONENT  TOTAL        TOTAL
ALABAMA             9                   9          0
ALASKA                        3         9          3
ARIZONA             6                   15         3
ARKANSAS                      6         15         9
CALIFORNIA                    45        15         54
COLORADO                      7         15         61
CONNECTICUT                   8         15         69
DELAWARE            3                   18         69
D.C.                3                   21         69
FLORIDA                       17        21         86
GEORGIA                       12        21         98
HAWAII                        4         21         102
IDAHO                         4         21         106
ILLINOIS            26                  47         106
INDIANA             13                  60         106
IOWA                8                   68         106
KANSAS                        7         68         113
KENTUCKY            9                   77         113
LOUISIANA           10                  87         113
MAINE                         4         87         117
MARYLAND            10                  97         117
MASSACHUSSETTS                14        97         131
MICHIGAN            21                  118        131
MINNESOTA           10                  128        131
MISSISSIPPI                   7         128        138
MISSOURI                      12        128        150
MONTANA             4                   132        150
NEBRASKA                      5         132        155
NEVADA                        3         132        158
NEW HAMPSHIRE                 4         132        162
NEW JERSEY          17                  149        162
NEW MEXICO                    4         149        166
NEW YORK            41                  190        166
NORTH CAROLINA                13        190        179
NORTH DAKOTA                  4         190        183
OHIO                25                  215        183
OKLAHOMA                      8         215        191
OREGON                        6         215        197
PENNSYLVANIA        27                  242        197
RHODE ISLAND                  4         242        201
SOUTH CAROLINA                8         242        209
SOUTH DAKOTA                  4         242        213
TENNESSEE                     10        242        223
TEXAS                         26        242        249
UTAH                          4         242        253
VERMONT                       3         242        256
VIRGINIA                      12        242        268
WASHINGTON                    8         242        276
WEST VIRGINIA                 6         242        282
WISCONSIN           11                  253        282
WYOMING                       3         253        285
RONALD REAGAN IS THE WINNER OF THE  1980  PRESIDENTIAL ELECTION.
RONALD REAGAN HAS  285  ELECTORAL VOTES—MORE THAN HIS OPPONENT, JIMMY CARTER.
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```
5 CLEAR500
20 DIMST(10,15)
400 M$(1)="FEBRUARY":M$(2)="MARCH":M$(3)="APRIL":M$(4)="MAY":M$(5)="JUNE":M$(6)="JULY":M$(7)="AUGUST":
M$(8)="SEPTEMBER":M$(9)="OCTOB
ER"
410 A$="YOUR CAMPAIGN FUND HAS $###,###,###.##"
411 B$="                          $###,###,###.##       $###,###,###.##
412 D$="CONTRIBUTIONS = $$###,###.##     EXPENDITURES = $$###,###.##"
500 FORI=1TO6:ST(1,I)=50:ST(5,I)=50:NEXT
510 FORI=1TO13:ST(2,I)=50:ST(4,I)=50:NEXT
520 FORI=1TO7:ST(3,I)=50:ST(6,I)=50:NEXT
530 F=0:A#=500000
600 CLS:PRINTCHR$(23):PRINT:PRINT:PRINT"THE PRESIDENTIAL CAMPAIGN"
615 FORI=1TO2000:NEXT
620 GOSUB31000
1000 CLS
1010 PRINTTAB(10);"C O N D I T I O N S":PRINT:PRINT
1020 PRINT"CHOOSE THE CONDITIONS THAT YOU WISH TO BE TRUE. ":PRINT
1030 INPUT"IN WHAT YEAR WILL THE ELECTION BE ";EY
1031 IFEY/4=INT(EY/4)GOTO1040
1032 PRINT"THAT IS NOT AN ELECTION YEAR":GOTO1030
1040 INPUT"WHAT IS YOUR NAME ";N$
1045 INPUT"WHAT IS YOUR OPPONENTS NAME ";O$
1050 PRINT:PRINT"TYPE '1' TO BE THE INCUMBENT"
1055 PRINT"TYPE '2' TO BE THE CHALLENGER"
1060 INPUT"     WHAT IS YOUR CHOICE ";P1:IFP1<1ORP1>2GOTO1060
1065 PRINT:PRINT"TYPE '1' TO BE A DEMOCRAT"
1070 PRINT"TYPE '2' TO BE A REPUBLICAN"
1075 INPUT"     WHICH POLITICAL PARTY ";P2:IFP2<1ORP2>2GOTO1075
1100 PR=RND(100)
1110 IFPR<30THENPA=-8
1120 IFPR>=30ANDPR<40THENPA=-5
1130 IFPR>=40ANDPR<55THENPA=2
1140 IFPR>=55ANDPR<65THENPA=6
1150 IFPR>=65THENPA=10
1160 IFP1=2THENPA=-PA
1170 FORI=1TO6:C(I)=PA:NEXT
1180 GOSUB20000
1200 C(1)=-8:C(2)=10:C(3)=-15:C(4)=12:C(5)=6:C(6)=-9
1210 IFP2=1GOTO1290
1220 FORI=1TO6:C(I)=-C(I):NEXT
1290 GOSUB20000
2000 CLS:PRINTTAB(20);"I S S U E S":PRINT
2010 PRINTN$;", WHICH OF THE FOLLOWING ISSUES:
2011 PRINTTAB(8);"(INPUT THE NUMBER, NOT THE PHRASE, PLEASE)
2015 PRINT"1) UNEMPLOYMENT";TAB(32);"4) SOCIAL ADJUSTMENTS"
2020 PRINT"2) INFLATION";TAB(32);"5) DEFENSE"
2025 PRINT"3) ENERGY";TAB(32);"6) FOREIGN AFFAIRS"
2030 PRINT:INPUT"IS MOST IMPORTANT TO YOUR CAMPAIGN ";I1
2035 INPUT"WHICH IS LEAST IMPORTANT TO YOUR CAMPAIGN ";I2
3000 FORT=1TO9
3010 CLS:PRINT"DATE: ";M$(T);" ";EV;TAB(32);(10-T);" MO. BEFORE ELECTION"
3015 CM#=0:TS#=0
3020 PRINTUSINGA$;A#:AB#=A#:MD=0
3030 INPUT"WHAT STATE DO YOU WISH TO VISIT ";V$
3035 PRINT"YOU HAVE ";(30-MD);" UNSCHEDULED DAYS LEFT THIS MONTH."
3040 INPUT"HOW MANY DAYS DO YOU WISH TO SPEND THERE ";DV
3045 IFMD+DV>30GOTO3040
3046 MD=MD+DV
3050 PRINT"HOW MANY OF THE ";DV;" DAYS WILL BE FOR FUND RAISING AND HOW":PRINT"MANY DAYS WILL BE FOR CAMPAIGNING."
3060 INPUT"DAYS CAMPAIGNING ";DC
3070 INPUT"DAYS FUND RAISING ";DF
3080 IFDV<DC+DFGOTO3050
3090 RESTORE
3100 READST$,EV,I,J
3105 IFST$<>"END"GOTO3110
3106 PRINT"YOU DID NOT SPELL THE STATE CORRECTLY.  TRY AGAIN."
3107 MD=MD-DV:GOTO3030
3110 IFST$<>V$GOTO3100
3120 CC#=INT(EV*1600*(DF/30)):CE=DV*1100:A#=A#+CC#-CE:CM#=CM#+CC#:TS#=TS#+CE
3130 ST(I,J)=ST(I,J)+INT((100-ST(I,J))*DC/30)
3140 IFMD>=30GOTO3160
3150 INPUT"DO YOU WISH TO VISIT ANOTHER STATE (YES/NO) ";C$
3152 IFC$="YES"GOTO3030
3160 CLS
3200 INPUT"SPEND CAMPAIGN MONEY IN WHAT STATE ";SP$
3210 PRINTUSINGA$;A#
3215 PRINT:PRINT"THE MOST YOU CAN SPEND AT ONE TIME IN A STATE IS $50,000."
3220 INPUT"HOW MUCH DO YOU WISH TO SPEND ";AS
3225 IFAS>50000GOTO3215
3230 IFAS>A#GOTO3210
3240 A#=A#-AS:TS#=TS#+AS
3245 RESTORE
3250 READST$,EV,I,J
3253 IFST$<>"END"GOTO3260
3255 PRINT"YOU DID NOT SPELL THE STATE CORRECTLY.  TRY AGAIN."
3256 A#=A#+AS:GOTO3200
3260 IFST$<>SP$GOTO3250
3270 ST(I,J)=ST(I,J)+INT((100-ST(I,J))*AS/10000*(1/EV))
3280 IFA#<=0GOTO4000
3290 INPUT"DO YOU WISH TO SPEND MONEY IN ANOTHER STATE (YES/NO)";C$
3300 IFC$="YES"GOTO3200
4000 CLS:PRINTTAB(15);"MONTHLY REPORT TO THE ELECTION COMMITTEE"
```

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CIRCLE 145 ON READER SERVICE CARD

```
4010 PRINT"CAMPAIGN FUNDS        BEGINNING OF MONTH    END OF MONTH
4020 PRINTUSINGB$;AB#;A#:PRINT
4030 PRINTUSINGD$;CM#,TS#
4040 PL=RND(51):RESTORE
4050 FORZ=1TOPL:READST$,EV,I,J:NEXT
4060 IFST(I,J)>50GOTO4100
4070 IFST(I,J)<50GOTO4120
4080 PRINT"POLLS SHOW YOU ARE EVEN WITH ";O$
4090 PRINT"IN ";ST$;".":GOTO4140
4100 PRINT"POLLS SHOW YOU ARE AHEAD OF ";O$
4110 PRINT"IN ";ST$;".  YOU HAVE ";ST(I,J);"% OF THE VOTE.":GOTO4140
4120 PRINT"POLLS SHOW ";O$;" IS AHEAD OF YOU"
4130 PRINT"IN ";ST$;".  HE HAS ";(100-ST(I,J));"% OF THE VOTE."
4140 INPUT"PRESS 'ENTER' TO BEGIN NEXT MONTH ";Z$
4900 CLS:GOSUB21000
4910 FORY=1TO6:ST(1,Y)=ST(1,Y)-2:ST(5,Y)=ST(5,Y)-2:NEXT
4911 FORY=1TO13:ST(2,Y)=ST(2,Y)-2:ST(4,Y)=ST(4,Y)-2:NEXT
4912 FORY=1TO7:ST(3,Y)=ST(3,Y)-2:ST(6,Y)=ST(6,Y)-2:NEXT
4998 INPUT"      PRESS 'ENTER'";C$
4999 NEXTT
5000 CLS:PRINTTAB(20);"ELECTION NIGHT RESULTS":PRINT:PRINTTAB(23);"ELECTORAL VOTES"
5001 PRINTTAB(40);"YOUR";TAB(50);"OPPONENT'S"
5002 PRINT"STATE";TAB(20);"YOU";TAB(30);"OPPONENT";TAB(40);"TOTAL";TAB(50);"TOTAL"
5100 RESTORE
5105 FORK=1TO51
5110 READST$,EV,I,J
5130 IFST(I,J)>50GOTO5140
5132 OT=OT+EV:X=30:GOTO5150
5140 YT=YT+EV:X=20
5150 PRINTST$;TAB(X);EV;TAB(40);YT;TAB(50);OT
5160 FORTM=1TO750:NEXTTM
5190 NEXT
5200 IFYT>OTGOTO5240
5205 W$=O$:L$=N$:WT=OT:GOTO5250
5240 W$=N$:L$=O$:WT=YT
5250 PRINTW$;" IS THE WINNER OF THE ";EV;" PRESIDENTIAL ELECTION."
5260 PRINTW$;" HAS ";WT;" ELECTORAL VOTES--MORE THAN HIS OPPONENT, ";L$;"."
9999 END
20000 FORI=1TO6:ST(1,I)=ST(1,I)+C(1):ST(5,I)=ST(5,I)+C(5):NEXT
20001 FORI=1TO13:ST(2,I)=ST(2,I)+C(2):ST(4,I)=ST(4,I)+C(4):NEXT
20002 FORI=1TO7:ST(3,I)=ST(3,I)+C(3):ST(6,I)=ST(6,I)+C(6):NEXT
20003 RETURN
21000 PE=RND(8)
21010 IFPE>1GOTO21100
21020 PRINT"THE U. S. IS THE TARGET OF DEMONSTRATIONS IN SEVERAL MIDDLE":PRINT"EAST
      COUNTRIES.":PRINT"SEVERAL EUROPEAN COUNTRIES HAV
E ALSO BEEN CRITICAL OF OUR":PRINT"FOREIGN POLICY.":C=0
21030 IFP1=1THENC=C-1
21040 IFP1=2THENC=C+1
21050 IFI1=6THENC=C+1
21060 IFI2=6THENC=C-1
21065 FORY=1TO6:C(Y)=C:NEXT
21070 GOSUB20000
21080 GOTO21999
21100 IFPE>2GOTO21200
21110 IN=RND(2)
21120 PRINT"THE RATE OF INFLATION HAS ";
21125 IFIN=1THEN IN$="DROPPED"
21130 IFIN=2THENIN$="RISEN"
21135 PRINTIN$:C=0
21140 IFP1=1GOTO21175
21145 IFI1=1THENC=C+1
21150 IFI2=1THENC=C-1
21160 IFIN=1THENC=C+1
21175 IFIN=1THENC=C+1
21180 IFIN=2THENC=C-1
21185 FORY=1TO6:C(Y)=C:NEXT
21190 GOTO21999
21200 IFPE>3GOTO21300
21205 PRINT"THERE IS A SHORTAGE OF ALL PETROLEUM PRODUCTS--ESPECIALLY":PRINT"GASOLINE.
      THE REASONS FOR THE SHORTAGE ARE UNCLEAR AT
THIS":PRINT"TIME.":C=1
21210 IFI1=3THENC=C+1
21220 IFI2=3THENC=C-1
21230 IFP1=1THENC=-C
21240 FORY=1TO6:C(Y)=C:NEXT
21250 GOSUB20000
21287 GOTO21999
21300 IFPE>4GOTO21400
21305 PB=RND(10000)+10000
21310 PRINT"A POLITICAL BOSS PROMISES TO CONTRIBUTE ";PB;" DOLLARS TO YOUR":PRINT
      "CAMPAIGN IF YOU WILL APPOINT SOME OF HIS FRIENDS T
O POWERFUL":PRINT"POSITIONS IF YOU WIN.  THIS CONTRIBUTION IS NOT LEGAL."
21315 INPUT"WILL YOU ACCEPT THE CONTRIBUTIONS (YES/NO) ";C$
21320 IFC$="NO"GOTO21999
21325 IFC$="YES"GOTO21335
21330 GOTO21315
21335 F=F+1:A#=A#+PB
21340 GOTO21999
21400 IFPE>5GOTO21500
21405 PRINT"ALLEGATIONS HAVE BEEN MADE THAT YOU HAVE ACCEPTED ILLEGAL":PRINT
      "CAMPAIGN FUNDS.  YOU ARE PRESENTLY UNDER INVESTIGATION.
21410 IFF=0GOTO21450
21415 IFF>=5GOTO21417
21416 PRINT"YOU HAVE BEEN FOUND GUILTY AND YOU LOSE ";"INT(100/(G-F);:PRINT"PERCENT OF YOUR SUPPORT IN EACH STATE."
21417 PRINT"YOU HAVE BEEN FOUND GUILTY AND THROWN IN THE FEDERAL PEN AT":PRINT"LEAVENWORTH, KANSAS FOR TWENTY YEARS."
                                                                                                                    :END
21420 FORY=1TO6:ST(1,Y)=INT((1/(G-F))*ST(1,Y)):ST(5,Y)=INT((1/(G-F))*ST(5,Y)):NEXT
21421 FORY=1TO13:ST(2,Y)=INT((1/(G-F))*ST(5,Y)):ST(4,Y)=INT((1/(G-F))*ST(4,Y)):NEXT
21422 FORY=1TO7:ST(3,Y)=INT((1/(G-F))*ST(3,Y)):ST(6,Y)=INT((1/(G-F)):ST(6,Y)):NEXT
21425 GOTO21999
21450 PRINT"YOU HAVE BEEN FOUND INNOCENT.":GOTO21999
21500 IFPE>6GOTO21600
21505 PRINT"YOU AND ";O$;" AGREE TO A TELEVISED DEBATE."
21510 IFI1>1GOTO21520
21515 FORY=1TO12:ST(2,Y)=ST(2,Y)+INT(.07*(100-ST(2,Y)))
21520 IFI1<>5GOTO21530
21525 FORY=1TO13:ST(4,Y)=ST(4,Y)+INT(.06*(100-ST(4,Y)))
21530 IFI2>1GOTO21540
21535 FORY=1TO12:ST(2,Y)=ST(2,Y)-INT(.05*ST(2,Y))
21540 IFI2<>5GOTO21550
21545 FOORY=1TO13:ST(4,Y)=ST(4,Y)-INT(.02*ST(2,Y))
21550 DB=RND(3)
21555 IFDB=2GOTO21586
21560 IFDB=1GOTO21581
21570 FORY=1TO6:ST(1,Y)=ST(1,Y)+INT(.02*(100-ST(1,Y))):ST(5,Y)=ST(5,Y)+INT(.02*(100-ST(5,Y))):NEXT
21571 FORY=1TO13:ST(2,Y)=ST(2,Y)+INT(.01*(100-ST(2,Y))):ST(4,Y)=ST(4,Y)+INT(.01*(100-ST(4,Y))):NEXT
21572 FORY=1TO7:ST(3,Y)=ST(3,Y)+INT(.01*(100-ST(3,Y))):ST(6,Y)=ST(6,Y)+INT(.01*(100-ST(6,Y))):NEXT
21580 GOTO21585
21581 FORY=1TO6:ST(1,Y)=ST(1,Y)-INT(.02*ST(1,Y)):ST(5,Y)=ST(5,Y)-INT(.02*ST(5,Y)):NEXT
21582 FORY=1TO13:ST(2,Y)=ST(2,Y)-INT(.01*ST(2,Y)):ST(4,Y)=ST(4,Y)-INT(.01*ST(4,Y)):NEXT
21583 FORY=1TO7:ST(3,Y)=ST(3,Y)-INT(.01*ST(3,Y)):ST(6,Y)=ST(6,Y)-INT(.01*ST(6,Y)):NEXT
21585 IFDB=1PRINT"YOU LOST THE DEBATE."
21586 IFDB=2PRINT"THE DEBATE WAS A DRAW."
21587 IFDB=3PRINT"YOU WON THE DEBATE."
21590 GOTO21999
21600 IFPE>7GOTO21700
21602 PRINT"THE PRESIDENT OF A LARGE UNION PROMISES THE SUPPORT OF THE"
      :PRINT"UNION'S MEMBERS IF YOU MAKE SOME PRO-UNION CAMPAIGN SP
EECHES."
21610 INPUT"WILL YOU ACCEPT HIS HELP ";C$
21615 IFC$="YES"GOTO21630
21620 IFC$="NO"GOTO21640
21625 GOTO21610
21630 C(1)=0:C(2)=2:C(3)=-2:C(4)=-1:C(5)=1:C(6)=-1:GOSUB20000
21635 GOTO21999
21640 C(1)=0:C(2)=-2:C(3)=3:C(4)=1:C(5)=0:C(6)=0:GOSUB20000
21645 GOTO21999
21700 PRINT"FARMERS AND RANCHERS WANT YOU TO CAMPAIGN THAT THEY SHOULD"
      :PRINT"RECEIVE HIGHER PRICES FOR THEIR PRODUCTS.  KEEP IN MIN
D THE":PRINT"CONSUMERS WILL NOT LIKE THIS.":C=0
21705 INPUT"WILL YOU SUPPORT THE FARMERS AND RANCHERS (YES/NO)";C$
21710 IFC$="YES"GOTO21725
21715 IFC$="NO"GOTO21730
21720 GOTO21705
21725 C(1)=-1:C(2)=-1:C(3)=3:C(4)=2:C(5)=-1:C(6)=2:GOTO21840
21730 C(1)=2:C(2)=3:C(3)=-2:C(4)=-2:C(5)=1:C(6)=-2
21840 GOSUB20000
21999 RETURN
30000 DATAALABAMA,9,4,9
30010 DATAALASKA,3,5,4
30020 DATAARIZONA,6,6,4
30030 DATAARKANSAS,6,4,12
30040 DATACALIFORNIA,45,5,6
30050 DATACOLORADO,7,6,7
30060 DATACONNECTICUT,8,1,5
30070 DATADELAWARE,3,2,3
30080 DATAD.C.,3,2,12
30090 DATAFLORIDA,17,4,7
30100 DATAGEORGIA,12,4,8
30110 DATAHAWAII,4,5,5
30120 DATAIDAHO,4,5,1
30130 DATAILLINOIS,26,2,9
30140 DATAINDIANA,13,2,8
30150 DATAIOWA,8,3,2
30160 DATAKANSAS,7,3,5
30170 DATAKENTUCKY,9,4,3
30180 DATALOUISIANA,10,4,11
30190 DATAMAINE,4,1,1
30200 DATAMARYLAND,10,2,5
30210 DATAMASSACHUSETTS,14,1,5
30220 DATAMICHIGAN,21,2,7
30230 DATAMINNESOTA,10,2,11
30240 DATAMISSISSIPPI,7,4,10
30250 DATAMISSOURI,12,4,13
30260 DATAMONTANA,4,3,6
30270 DATANEBRASKA,5,3,4
30280 DATANEVADA,3,6,5
30290 DATANEW HAMPSHIRE,4,1,2
30300 DATANEW JERSEY,17,2,4
30310 DATANEW MEXICO,4,6,3
30320 DATANEW YORK,41,2,1
30330 DATANORTH CAROLINA,13,4,5
30340 DATANORTH DAKOTA,4,3,1
30350 DATAOHIO,25,2,6
30360 DATAOKLAHOMA,8,6,2
30370 DATAOREGON,6,5,3
30380 DATAPENNSYLVANIA,27,2,2
30390 DATARHODE ISLAND,4,1,6
30400 DATASOUTH CAROLINA,8,4,6
30410 DATASOUTH DAKOTA,4,3,3
30420 DATATENNESSEE,10,4,4
30430 DATATEXAS,26,6,1
30440 DATAUTAH,4,6,6
30450 DATAVERMONT,3,1,3
30460 DATAVIRGINIA,12,4,2
30470 DATAWASHINGTON,8,5,2
30480 DATAWEST VIRGINIA,6,4,1
30490 DATAWISCONSIN,11,2,10
30500 DATAWYOMING,3,3,7
30510 DATAEND,0,0,0
31000 CLS:PRINTTAB(25);"S C E N A R I O":PRINT
31010 PRINT"   YOU HAVE DECIDED TO RUN FOR PRESIDENT.  AND HAVE OBTAINED"
31020 PRINT"NOMINATION OF YOUR PARTY.  THE CAMPAIGN BEGINS NINE MONTHS"
31030 PRINT"BEFORE THE ELECTION.  YOU HAVE THE OPTIONS OF DECIDING WHICH"
31040 PRINT"STATES TO VISIT EACH MONTH, HOW MANY DAYS YOU WANT TO SPEND IN"
31050 PRINT"THE STATES YOU CHOOSE TO VISIT, AND WHETHER THE VISIT IS FOR"
31060 PRINT"CAMPAIGNING (WHICH WINS POPULAR VOTES), OR FOR FUND RAISING"
31070 PRINT"(WHICH WINS NO POPULAR VOTES, BUT BRINGS IN CONTRIBUTIONS TO"
31080 PRINT"MEET EXPENSES AND FINANCE CAMPAIGN ACTIVITIES IN OTHER STATES)."
31090 PRINT"THE MONEY THAT IS IN THE CAMPAIGN TREASURY CAN BE SPENT AS YOU"
31100 PRINT"WISH IN ANY STATE."
31110 PRINT:INPUT"PRESS 'ENTER' TO CONTINUE SCENARIO ";C$
31120 CLS:PRINT"   AT THE BEGINNING OF THE CAMPAIGN, YOU ARE ALLOWED TO MAKE"
31130 PRINT"SOME POLITICAL DECISIONS.  THESE WILL AFFECT THE INITIAL"
31140 PRINT"ATTITUDES OF THE VOTERS WITH RESPECT TO YOU AND YOUR OPPONENT."
31150 PRINT"THROUGH OUT THE CAMPAIGN, YOU WILL HAVE TO MAKE ADDITIONAL"
31160 PRINT"POLITICAL DECISIONS THAT WILL INFLUENCE VOTER OPINION.  AS"
31170 PRINT"WITH ALL POLITICAL DECISIONS, WHATEVER YOU DECIDE WILL NOT"
31180 PRINT"PLEASE EVERYBODY.  IN ADDITION, SOME OF YOUR DECISIONS WILL BE"
31190 PRINT"COMPARED TO DECISIONS YOU HAVE MADE EARLIER TO DETERMINE YOUR"
31200 PRINT"SINCERITY.  SO WEIGH THE IMPLICATIONS OF EACH DECISION"
31210 PRINT"CAREFULLY.  IN SOME CASES, CHANGING POSITIONS DURING A"
31220 PRINT"CAMPAIGN CAN BE THE BEST STRATEGY, OTHER TIMES IT MAY BE"
31230 PRINT"DISASTROUS."
31240 PRINT:INPUT"PRESS 'ENTER' TO CONTINUE SCENARIO ";C$
31250 CLS:PRINT"   AT THE END OF EACH MONTH YOU WILL RECEIVE A REPORT OF THE"
31260 PRINT"FINANCES OF THE CAMPAIGN TREASURY.  YOU WILL BE SHOWN THE"
31270 PRINT"     BALANCE AT THE BEGINNING OF THE MONTH"
31280 PRINT"     BALANCE AT THE END OF THE MONTH"
31290 PRINT"     TOTAL CONTRIBUTIONS DURING THE MONTH"
31300 PRINT"     TOTAL EXPENDITURES DURING THE MONTH"
31310 PRINT"   CAMPAIGNING IS EXPENSIVE, NOT JUST THE MONEY YOU DECIDE TO"
31320 PRINT"SPEND IN STATES, BUT ALSO FOR YOUR ACTUAL CAMPAIGN VISITS TO"
31330 PRINT"THE VARIOUS STATES.  IT IS HELPFUL TO SPEND TIME FUND RAISING"
31340 PRINT"ON VISITS TO OTHER STATES TO MAINTAIN THE CAMPAIGN TREASURY"
31350 PRINT"WITH CONTRIBUTIONS."
31370 PRINT:INPUT"PRESS 'ENTER' TO CONTINUE SCENARIO ";C$
31380 CLS:PRINT"   THERE ARE A FEW CAMPAIGN LAWS:"
31390 PRINT"   YOU CAN NOT PUT THE CAMPAIGN TREASURY IN DEBT."
31400 PRINT"   A $50,000 MAXIMUM IS PLACED ON EACH TRANSACTION."
31410 PRINT"   UNREPORTED CAMPAIGN CONTRIBUTIONS ARE ILLEGAL."
31420 PRINT"      (YOU MAY BE TEMPTED TO ACCEPT SOME IF THE TREASURY"
31430 PRINT"      GETS LOW ON FUNDS.  YOU MAY EVEN GET AWAY WITH IT."
31440 PRINT"      YOU MAY GET AWAY WITH IT MORE THAN ONCE.  HOWEVER,"
31450 PRINT"      YOU MIGHT GET CAUGHT.  IT MAY COST YOU THE ELECTION."
31460 PRINT"      IT MAY JUST COST YOU A FEW VOTES.)
31470 PRINT"   YOU CAN CAMPAIGN AS MANY DAYS PER MONTH AS YOU WISH AND"
31480 PRINT"       VISIT AS MANY STATES AS YOU WISH; THE MAXIMUM DAYS"
31490 PRINT"       AVAILABLE EACH MONTH TO CAMPAIGN IS 30."
31500 PRINT:INPUT"PRESS 'ENTER' TO CONTINUE SCENARIO ";C$
31510 CLS:PRINT"   AT THE END OF EACH MONTH, YOU WILL BE SHOWN YOUR STATUS"
31520 PRINT"IN ONE STATE--AS OF THE END OF THAT MONTH.  THIS IS THE ONLY"
31530 PRINT"INDICATION YOU WILL RECEIVE ON YOUR PROGRESS."
31540 PRINT"   AT THE END OF THE CAMPAIGN, THE ELECTION IS HELD AND YOU"
31550 PRINT"WILL RECEIVE A STATE BY STATE ACCOUNTING OF THE RESULTS."
31560 PRINT"YOU WILL BE SHOWN THE NUMBER OF ELECTORAL VOTES AWARDED BY"
31570 PRINT"EACH STATE, TO WHOM THEY WERE AWARDED, THE TOTAL ELECTORAL"
31580 PRINT"VOTES YOU HAVE RECEIVED AND THE TOTAL ELECTORAL VOTES YOUR"
31590 PRINT"OPPONENT HAS RECEIVED."
31600 PRINT:INPUT"PRESS 'ENTER' FOR SPECIFIC INSTRUCTIONS ";C$
31610 PRINT"1)  BE SURE TO SPELL EACH STATE CORRECTLY."
31620 PRINT"2)  DO NOT USE A DOLLAR SIGN WHEN ENTERING AMOUNTS OF MONEY."
31630 PRINT"3)  DO NOT USE A COMMA WHEN ENTERING NUMBERS."
31640 PRINT:INPUT"PRESS 'ENTER' TO BEGIN THE CAMPAIGN ";C$
31650 RETURN
```

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Unique Solutions to the Checkerboard Problem

Bhairav Joshi

> *APL is a lean, mean language that's terrific for mathematical stuff. Here's a nice example.* — *TN*

In the January issue (p. 122) Geoffrey Chase presented a technique to solve the checkerboard problem. The computer program presented by Chase produces a number of incorrect solutions. A correct analysis, and a program to generate all correct solutions, was presented by A. Reed in the May issue (p. 94). However, Abijah Reed's program does not take into account the symmetry of the checkerboard and, therefore, generates many symmetry equivalent solutions. In this note I will describe the necessary modifications to Reed's algorithm to generate only the unique solutions.

Symmetry of the Checkerboard

A checkerboard is a square and has seven interesting symmetry elements which can be used to eliminate symmetry-equivalent solutions generated by Reed's program. Four of these symmetry elements (see Figure 1) are vertical planes passing through lines PR, SQ, AC and BD. I will denote these by mnemonic symbols ⌽, ⊖, ⍉ and ⌀, respectively. The remaining three symmetry elements are rotations of the checkerboard, around a vertical line passing through its center, 0, by 90, 180 and 270 degrees, respectively. Let me denote these by R1, R2 and R3.

⌀ = ⌽ ⊖ ⍉ ,
R1 = ⊖ ⍉ ,
R2 = ⌽ ⊖ , and
R3 = ⍉ ⊖ .

Effect of Symmetry-Elements On Column Numbers

Reed's algorithm generates solutions by simply listing column numbers for each row where a checker is located. The effect of ⌽, ⊖, ⍉, ⌀, R1, R2 and R3 on column numbers is easy to work out if it is recognized that

⌀ = ⌽ ⊖ ⍉ ,
R1 = ⊖ ⍉ ,
R2 = ⌽ ⊖ , and
R3 = ⍉ ⊖ .

The effect of ⌽, ⊖ and ⍉ on a set of column numbers, J, is as follows:

⌽ J ⟹ (generates) 1#N–J
⊖ J ⟹ J in reversed order, and
⍉ J ⟹ indices needed to arrange J in an ascending order.

For example, the first solution

```
      ∇ UNIQUE∆CKBD [⎕] ∇

     ∇ R UNIQUE∆CKBD N;K;P;A;B;Q;Z;⎕IO
[1]   Q←N+⎕IO←1
[2]   Z←(1,N)⍴P←⍳N
[3]  L2:→((1≠+/P=⍳N)∨1≠+/(P+⍳N)=N+1)/L1
[4]   →(∨/∨/((((8,N)⍴(⍉A),(Q-A),(⌽B),(Q-⌽B),(B←⍉P),(A←⌽P),(
      Q-P),P)∧.=⍉Z))/L1
[5]   Z←Z,[1] P
[6]  L1:P←PERM P
[7]   →(1≠⍴P)/L2
[8]   'NUMBER OF UNIQUE SOLUTIONS: ',⍕1↑⍴Z← 1 0 ↓Z
[9]   →('P'≠1↑R)/0
[10]  Z
     ∇


            'P' UNIQUE∆CKBD 4

      NUMBER OF UNIQUE SOLUTIONS: 1
       1 3 4 2


            'P' UNIQUE∆CKBD 5

      NUMBER OF UNIQUE SOLUTIONS: 4
       1 3 5 2 4
       1 4 5 3 2
       2 1 3 5 4
       2 5 3 1 4


            'P' UNIQUE∆CKBD 6
      NUMBER OF UNIQUE SOLUTIONS: 12
       1 3 4 2 6 5
       1 3 4 5 6 2
       1 3 5 6 2 4
       1 3 6 5 2 4
       1 4 5 3 6 2
       1 4 5 6 2 3
       1 4 6 5 2 3
       1 6 4 5 3 2
       2 1 4 6 5 3
       2 5 1 4 6 3
       2 5 3 6 1 4
       2 5 6 4 1 3

             'N' UNIQUE∆CKBD 7

      NUMBER OF UNIQUE SOLUTIONS: 86
```

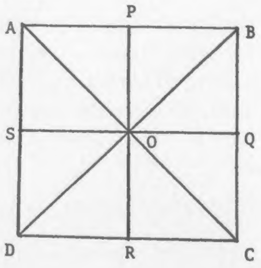

Figure 1

Bhairav Joshi, State University College, Geneseo, NY 14454.

```
1 3 4 5 7 2 6     2 1 4 7 3 6 5
1 3 4 6 7 2 5     2 1 5 7 4 6 3
1 3 4 7 6 2 5     2 1 6 4 7 3 5
1 3 5 2 4 7 6     2 1 6 4 7 5 3
1 3 5 2 6 7 4     2 1 7 4 6 5 3
1 3 5 2 7 4 6     2 3 1 4 6 7 5
1 3 5 6 2 7 4     2 3 1 4 7 5 6
1 3 5 6 4 7 2     2 3 5 1 7 6 4
1 3 5 6 7 4 2     2 3 5 7 1 6 4
1 3 5 7 2 4 6     2 3 6 4 1 7 5
1 3 5 7 6 4 2     2 3 6 4 7 1 5
1 3 6 5 7 2 4     2 3 7 4 1 5 6
1 3 6 7 4 2 5     2 3 7 4 6 1 5
1 3 7 5 4 2 6     2 4 1 7 3 6 5
1 3 7 5 6 2 4     2 4 5 1 7 6 3
1 3 7 6 4 2 5     2 4 5 7 1 6 3
1 4 5 2 6 7 3     2 4 7 1 3 6 5
1 4 5 2 7 3 6     2 5 1 4 7 3 6
1 4 5 3 2 7 6     2 5 1 7 3 6 4
1 4 5 3 6 7 2     2 5 6 4 1 7 3
1 4 5 6 2 7 3     2 5 6 4 7 1 3
1 4 5 6 7 3 2     2 5 7 1 3 6 4
1 4 5 7 2 3 6     2 5 7 4 1 3 6
1 4 5 7 6 3 2     2 5 7 4 6 1 3
1 4 6 3 7 2 5     2 6 1 3 5 7 4
1 4 6 5 3 7 2     2 6 1 7 5 3 4
1 4 6 5 7 2 3     2 6 1 7 5 4 3
1 4 6 7 3 5 2     2 6 3 1 7 4 5
1 4 7 3 6 2 5     2 6 3 1 7 5 4
1 4 7 5 6 2 3     2 6 3 5 1 7 4
1 4 7 6 3 5 2     2 6 3 5 7 1 4
1 5 4 3 7 2 6     2 6 3 7 1 4 5
1 5 4 6 3 7 2     2 6 3 7 1 5 4
1 5 4 6 7 2 3     2 6 3 7 4 1 5
1 5 4 7 6 2 3     2 6 4 7 5 1 3
1 5 6 3 7 2 4     2 6 7 1 5 3 4
1 5 6 7 3 4 2     2 6 7 1 5 4 3
1 5 6 7 4 2 3     2 6 7 3 5 1 4
1 5 7 3 4 2 6
1 5 7 3 6 2 4
1 5 7 6 3 4 2
1 5 7 6 4 2 3
1 6 4 3 7 5 2
1 6 4 5 7 3 2
1 6 7 3 4 5 2
1 6 7 5 4 3 2
1 7 4 6 3 5 2
1 7 5 6 4 3 2
```

Figure 2
Unique Solutions For N = 7 Case

produced by Reed's program for N = 4 case is the set of column numbers 1 3 4 2. Thus

⌽(1 3 4 2) = 1 + 4 − (1 3 4 2) = 4 2 1 3,
⊖(1 3 4 2) = 2 4 3 1 and
⍉(1 3 4 2) = 3 2 4 1.

In this way all sets of column numbers, which are equivalent to the set (1 3 4 2), can be generated.

A Program for Generating Unique Solutions

I have modified Reed's CKBD program so that it checks to see if the current solution is equivalent to the ones which have been generated in the previous steps. This is done in line 4 of the program UNIQUE∆CKBD (see Figure 1). In brief, line 4 generates all symmetry equivalent forms of the *current* solution and checks to see if any one of these is identical with those already found (and stored in Z). The current solution is unique, and therefore kept, if and only if no match is found.

The unique solutions for N = 4, 5 and 6 are listed in Figure 1. There are 86 unique solutions for N = 7 case (Figure 2).

The UNIQUE∆CKBD program uses Reed's PERM subroutine. □

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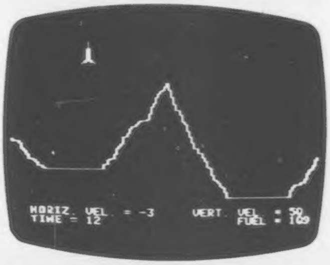
SCORE: 0



Saucer Invasion. Fire missles to destroy the invaders who fly at different speeds and altitudes.

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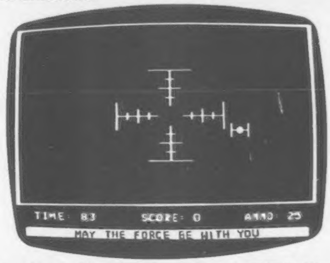

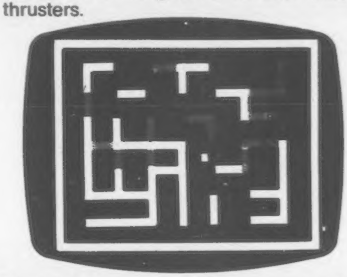

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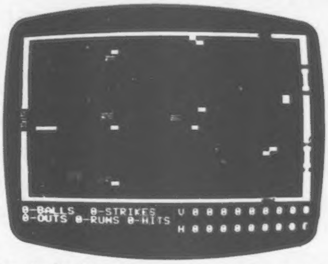

HIGH SCORE = 0
CURRENT SCORE = 70
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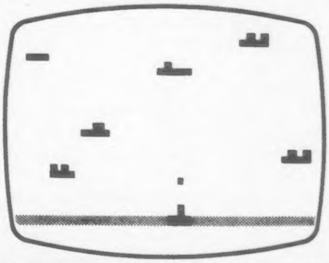

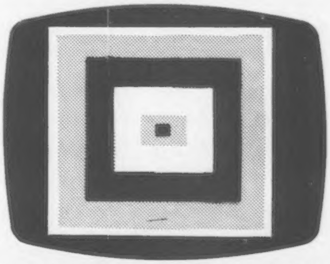

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Semantic Nets With Classes, Hierarchies and Much More

Property-List Structures

Neil C. Rowe

> *This is an Idea piece — it'll give you lots of thoughts on things to do with your computer. He doesn't give you the programs themselves, but it's obvious how to get started with it in Basic. What to do* **next**, *however, is another question entirely. When you've done everything suggested here, drop us a line.* —*TN*

Biological Classification

Let's start with the idea of "classifying," and an old and important example, the classification of living things. According to the scheme originating with the biologist Linnaeus, living things can be grouped into large classes, which may further be divided into subclasses, and so on.

This scheme of organization, called a "hierarchy," is easy to represent in a computer. Just create a bunch of variables whose names are the names of the classes, and whose values are lists of words (or character strings of words) representing the members of that class. For instance:

```
ANIMAL = [INVERTEBRATE CHORDATE]
INVERTEBRATE = [PROTOZOA WORM INSECT]
INSECT = [ANT MOSQUITO SPIDER]
CHORDATE = [BIRD FISH AMPHIBIAN MAMMAL]
BIRD = [SPARROW EAGLE PENGUIN]
FISH = [COD SHARK MINNOW]
AMPHIBIAN = [FROG]
MAMMAL = [BAT HORSE CARNIVORE PRIMATE]
CARNIVORE = [DOG CAT]
PRIMATE = [MONKEY MAN]
```

where "=" means the variable name on the left has as value the list in brackets on the right.

We can use this hierarchy to answer questions about what classes an animal belongs to. Just find the variable whose value contains the animal's name, then the variable that contains that name in turn, and so on until you reach the top of the hierarchy. So a dog is a carnivore, mammal, chordate and animal.

Dog is an example of carnivore, which is an example of mammal, which is an example of chordate, which has a spine. So examples give you a pathway upwards to search.

Adding Properties

The major disadvantage to the preceding is that saying a *dog* is a *carnivore* doesn't explain why — what this *means*. One possible fix is to refer to additional "properties" a class has. For instance, *fish* is the subclass of *chordate* whose members are (a) cold-blooded and (b) live in water all the time. This distinguishes them from *birds* and *mammals*, which are warm-blooded, and from *amphibians*, which are cold-blooded but don't live in water all the time.

We can represent this information as sublists within the list corresponding to a given class:

```
ANIMAL = [[EXAMPLE INVERTEBRATE] [EXAMPLE
        CHORDATE]]
INVERTEBRATE = [[EXAMPLE PROTOZOA] [EXAMPLE
        WORM]
    [EXAMPLE INSECT][HAS.NO SPINE]]
PROTOZOA = [[PROPERTY UNICELLULAR]]
WORM = [[PROPERTY MULTICELLULAR] [HAS.NO
    JOINTS]]
INSECT = [[EXAMPLE ANT] [EXAMPLE MOSQUITO]
    [EXAMPLE SPIDER]
    [PROPERTY MULTICELLULAR] [HAS JOINTS]
        [HAS CHITIN]]
CHORDATE = [[EXAMPLE BIRD] [EXAMPLE FISH]
    [EXAMPLE AMPHIBIAN]
    [EXAMPLE MAMMAL] [HAS SPINE] [PROPERTY
    MULTICELLULAR]]
BIRD = [[EXAMPLE SPARROW] [EXAMPLE EAGLE]
    [EXAMPLE PENGUIN]
    [HABITAT AIR] [PROPERTY WARM.BLOODED]]
FISH = [[EXAMPLE COD] [EXAMPLE SHARK]
    [EXAMPLE MINNOW]
    [HABITAT WATER] [PROPERTY COLD.BLOODED]]
AMPHIBIAN = [[EXAMPLE FROG] [HABITAT LAND]
    [PROPERTY COLD.BLOODED]]
MAMMAL = [[EXAMPLE BAT] [EXAMPLE HORSE]
    [EXAMPLE CARNIVORE]
    [EXAMPLE PRIMATE] [HABITAT LAND]
    [PROPERTY WARM.BLOODED]]
CARNIVORE = [[EXAMPLE DOG] [EXAMPLE CAT]
    [HAS CLAWS]
    [PROPERTY SMALL.BRAIN]]
PRIMATE = [[EXAMPLE MONKEY] [EXAMPLE MAN]
    [HAS NAILS]
    [PROPERTY LARGE.BRAIN]]
```

(Note that I treat the decimal point as a character just like letters. This, of course, enables you, the programmer, to find each new term simply by scanning for spaces.)

Here the information about a given class consists of a number of different things, as appropriate. There are *properties* of every member of a class; there are things

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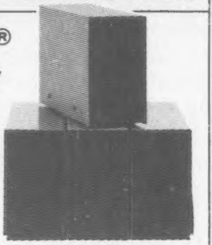

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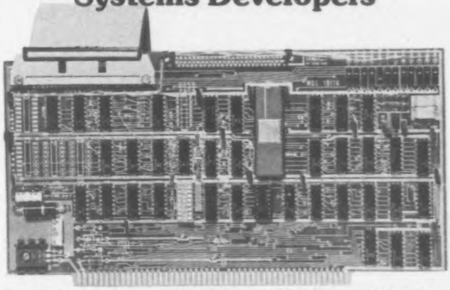

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Structures, cont'd...

that each member *has* as a part of them, or doesn't have (HAS.NO); there are special properties like *habitat* with potentially lots of different values; and last but not least, there is the information we had before, the *examples* (or members) of the class.

The above information is very incomplete; there's much more we could include about these animals, further subclasses we could create, etc.

Using Property Lists

Okay, so we've got this hierarchy consisting of property lists — also often called a "semantic network" — into our computer; what can we do with it? Besides using it as it is for a sort of outline (or "Cliff's Notes") for the information it covers, there seem to be three main uses: (1) answering questions about things contained in it, (2) drawing conclusions about things not contained in it, and (3) generating trains of "free association."

We discussed earlier how we can tell from these structures if an A is a B: we just look for *examples*, moving up the hierarchy from A to B. We can do something similar for other kinds of properties. For instance, *dog* has a *spine* even though it doesn't say so in the property list of *dog* itself; for *dog* is an *example* of *carnivore*, which is an *example* of *mammal*, which is an *example* of *chordate*, which *has* a *spine*. So *examples* give you a pathway upwards to search, if you need to, in answering a question.

We can also use these structures to classify new animals. For instance, if we find a warm-blooded animal with claws, we can guess that it's a carnivore, even though we don't have complete evidence for it: members of the carnivore class have the most "matches" to the unknown animal. We can make this approach more systematic: starting at the top of the hierarchy, we proceed downwards, at each point choosing the *example* whose information seems most consistent with the observed animal. When you've run out of further *examples*, or when the information associated with each *example* directly contradicts the observed animal, stop: that's your identification. (This approach can be extended to automatically construct hierarchies.)

Lastly, this property list structures can be used generatively: one can treat "up" and "down" the same and do a "random walk" around. See section below on "Association Structures."

Other Kinds of Hierarchies

But first we should note something very important: hierarchies can be organized on lots of different principles besides just the containment of one class inside another. For instance, "A is part of B,"or, when modeling social organizations, "A is responsible to B":

```
U.S.GOVERNMENT = [[PART EXECUTIVE.BRANCH]
[PART LEGISLATIVE.BRANCH][PART JUDICIAL.BRANCH]
        [PART OIL.COMPANIES]]
EXECUTIVE.BRANCH = [[PART PRESIDENT][PART
            CABINET]]
PRESIDENT = [[PROPERTY PERSON][PROPERTY
            ELECTED]]
CABINET = [[PART SECRETARY.STATE][PART
           SECRETARY.DEFENSE]
           [RESPONSIBLE.TO PRESIDENT]]
```

Thus we can have multiple hierarchies within the same structure. This is not necessarily confusing; almost all of the time we only have to deal with one hierarchy at a time. For instance, "Is the president's congressional liaison part of the executive branch?" vs. "Does he report to the president's chief of staff?"

> **Just find the variable whose value contains the animal's name, then the variable that contains that name in turn, and so on until you reach the top of the hierarchy.**

There are lots of other "flow of control" hierarchy applications. For instance, programmers will undoubtedly think of the flow of control in a complicated program. Many human activities have similarities to executing a program, for instance:

```
COOK.HAMBURGER = [[PART PREPARE.MEAT][PART
                 GET.BUN]
         [PART GET.CATSUP][PART GET.MUSTARD]
 [PART GET.PICKLES][PART ASSEMBLE.HAMBURGER]]
PREPARE.MEAT = [[PART GET.RAW.HAMBURGER][PART
                MAKE.PATTY]]
         [PART COOK.MEAT]]
MAKE.PATTY = [[PART TAKE.PORTION][PART
              FLATTEN.PORTION]]
COOK.MEAT = [[PART GET.FRYING.PAN][PART PLACE
             .PAN.ON.STOVE]
     [PART TURN.ON.HEAT][PART BROWN.MEAT]]
BROWN.MEAT = [[PART WATCH.COOKING][PART TURN.
             OVER]]
ASSEMBLE.HAMBURGER = [[PART OPEN.BUN][PART
                     ADD.MEAT]
          [PART ADD.CATSUP][PART ADD.MUSTARD]
                     [PART ADD.PICKLES]]
```

Partial-Ordering Structures

But nothing says the property list structures we create must be entirely hierarchical. Consider modeling maps:

```
USA = [[CAPITAL WASINGTON.D.C][STATE
       MASSACHUSETTS]
      [STATE ILLINOIS][STATE CALIFORNIA]]
MASSACHUSETTS = [[CAPITAL BOSTON][CITY BOSTON]
      [CITY CAMBRIDGE][NORTH.OF WASHINGTON.D.C]]
CAMBRIDGE = [[WEST.OF BOSTON][HAS.UNIVERSITY
              MIT]
      [HAS.UNIVERSITY HARVARD]]
MIT = [[EAST.OF HARVARD][WEST.OF BOSTON]]
HARVARD = [[WEST.OF MIT][WEST.OF BOSTON]]
```

Here the state and city properties do create a hierarchy. But the geographical properties are different: many separate places could have [WEST.OF BOSTON] in their property list, not just one. But it is true that if A is *west.of* B, and B is *west of* C, then A is *west of* C (what mathematicians call "transitivity").

Maps are a kind of picture, and we can in fact represent any picture similarly, using things like *right.of, above, inside, touches*, etc.:

```
FACE = [[PART HEAD][PART EYES][PART NOSE]
       [PART MOUTH]
HEAD = [[TYPE CIRCLE][SIZE LARGE]]
EYES = [[INSIDE HEAD][PART LEFT.EYE][PART
        RIGHT.EYE]
        [ABOVE NOSE]]
LEFT.EYE = [[TYPE CIRCLE][SIZE SMALL][LEFT.OF
           RIGHT.EYE]]
RIGHT.EYE = [[TYPE CIRCLE][SIZE SMALL]]
NOSE = [[TYPE TRIANGLE][INSIDE HEAD]
       [ABOVE MOUTH]]
MOUTH = [[TYPE ARC][ORIENTATION CONCAVE]
        [INSIDE HEAD]]
```

Note that the user should take advantage of the fact that if A is to the *right.of* B, then B is to the *left.of* A; similarly for *left, above, below*, etc. Oftentimes in particular property list situations you can find helpful rules like these.

Association Structures

Going a step further, we can say that things can be related for arbitrary reasons, just like the way very different things may get linked in the human mind by association. Calling this association property "x," consider:

```
ESMERELDA = [[X OH][X DEAR][X WOMAN][X MIND]
        [X WHOSE][X I]]
WOMAN = [[X FEMININE][X PRETTY][X KIND]
       [X THOUGHTFUL]
        [X ESMERELDA]]
MIND = [[X BRILLIANT][X SENSITIVE]
       [X PERCEPTIVE][X ESMERELDA]]
I = [[X ADORE][X WORSHIP][X LOVE][X YOU]]
YOU = [[X ESMERELDA][X WHOSE]]
WHOSE = [[X FORM][X FACE]]
FORM = [[X FACE][X LISSOME][X GORGEOUS]
       [X EXQUISITE]
       [X BEAUTIFUL][X ESMERELDA]]
FACE = [[X EYES][X NOSE][X SMILE][X PERFECT]
       [X FLAWLESS]]
EYES = [[X WIDE][X BLUE][X SHINY][X FACE]]
SMILE = [[X BROAD][X TOOTHY][X DELICATE]
        [X FACE]]
```

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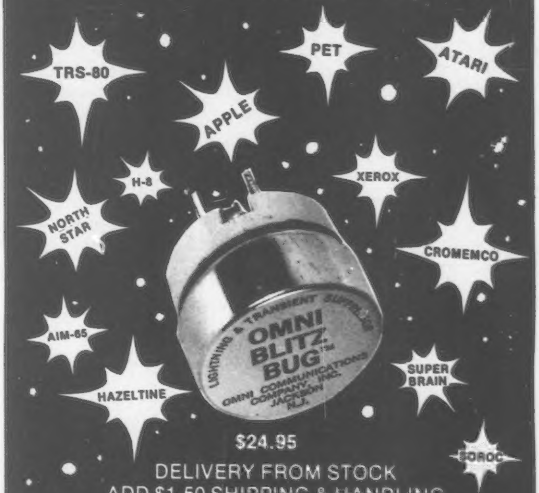

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Structures, cont'd...

We can generate free-form poetry from this by following the association chains around, printing the words we encounter. When we're at a word we print it and make a random choice among its property list. If we pick a word with no property list of its own, we print it and try again, else we go to the indicated word. Here's a sample:

```
ESMERELDA OH WOMAN THOUGHTFUL PRETTY

ESMERELDA I ADORE YOU

ESMERELDA MIND PERCEPTIVE

ESMERELDA WHOSE FACE SMILE TOOTHY FACE EYES

NOSE PERFECT FORM LISSOME BEAUTIFUL

ESMERELDA DEAR
```

where we've made a new line before each "Esmerelda" to give a more stanzaic form. (This "stream of consciousness" result isn't particularly grammatical; see my article in the January-February 1978 issue of *Creative* for a better way of getting grammatical poetry.)

Note still a hierarchic form of organization in the above property-list structure. This helps keep the structure easy to understand by indicating different levels of descriptive detail.

Further Applications

Here are some domains for which property-list structures can be built for a small computer. Note that some are harder than others.

trees
flowers
mushrooms
insects
birds
shells
rocks
minerals
fossils
gross geologic features (e.g., landforms)
stellar types
animals and plants interrelating in some habitat
chemical substances, based on test results
disease, based on tests on a patient
objects in a room (what a household robot would need to know)
simple shapes
alphabet letters, from their shapes
figuring out what a human is doing from seeing their bodily motions
different ideas of geography or astronomy, as per early civilizations
three-dimensional maps (e.g., buildings, caves, transportation networks)
the structure of some animal or plant
a nervous or circulatory system
the organization of a corporation
any bureaucracy
genealogies
a "Peyton Place" world in which people are related to one another in a number of different ways
inventory organization (e.g., stockroom)
descriptions of complex machines (e.g., mechanical clock, radio)
phonemes
the basic verbs of a language (see Margaret Boden, *Artificial Intelligence and Natural Man,* Basic Books, 1977, pp. 147-165)
the organization of the mind of a simple animal
human mental structures in some narrow field, both normal and with "bugs" (see Peter Lindsay and Donald Norman, *Human Information Processing,* Academic Press, 1972, chapters 10 & 11)
a set of interrelated beliefs someone has (e.g., a religion) (see Boden pp. 64-86, or the above chapters in Lindsay and Norman)
situations in some game (e.g., in bridge, classification of hands for bidding purposes)
a model of something technical (like a computer language) that can be used as an "interactive manual"
stories based on free-association ideas
music based on free-association ideas
"movies" based on free-association ideas

We can generate free-form poetry from this by following the association chains around, printing the words we encounter.

Further Programming Projects

(a) Donald Knuth (in Section 2.3 of *The Art of Computer Programming,* vol. 1 Addison-Wesley, 1968) discusses trees, a data structure with many similarities to those here. Investigate some of his ideas to improve efficiency. For instance, use "double-linking" to avoid searching when moving up the hierarchy.

(b) Develop a classifier program that uses numerical weights on properties to tell which are more important than others. See if you can extend this approach to handle situations with incomplete or uncertain data for the thing to be classified.

(c) Develop a way of handling "exceptions" to the general properties of a class. For instance, penguins are a special kind of bird that doesn't fly; but it still seems pretty much true that birds fly.

(d) Devise ways of having a certain number of parts to something. For instance, a man has two hands and each hand has five fingers.

(e) Lindsay and Norman point out an interesting anomaly: if *man* has a *brain, Tom* is an *example* of *man,* and *Dick* is an *example* of *man,* how do you distinguish one of their *brains* from another? For one brain can be smarter than another, etc. Can you give general rules to follow in building property-list structures?

(f) Devise ways of "backtracking" in classification when necessary. That is, you chose what you thought was the best option at some point, but later discover large discrepancies between what your classification predicts and what you have. How and where to go back to try again?

(g) SCHOLAR, a large program containing geographical information (see Carbonnell, in *IEEE Transactions on Man-Machine Systems,* vol. II no. 4) can answer questions in many interesting indirect ways. For instance, to "Is Peru the capital of Bolivia?" it will say something like "No, Peru is a country, not a city. La Paz is the capital of Bolivia." Add this facility of elaborating negative answers to your property list question answerer.

(h) Use your classifier program to play "twenty questions" (though on a small computer, you'd better limit it to ten or so).

(i) Consider developing a program to do more sophisticated kinds of "learning" of structures than just classifying new examples. For instance, allow for changes on already-made classifications when it seems like they really aren't working out. For example, if you classify a penguin as a mammal, you may run into trouble when trying to decide whether it's a bat or a marsupial. Read about Winston's program (see Boden, pp. 248-267).

(j) Make it easier to do all this by writing a pseudo-English interface to which you can say simple things like:

```
TOM IS A MAN

FIDO IS A DOG

TOM OWNS FIDO

FIDO HAS FLEAS
```

and it will understand. A "pattern matcher" will help in this; see Patrick Winston, *Artificial Intelligence* (Addison-Wesley, 1977), chapter 14.

(k) To the preceding, add the ability to handle plurals and adjectives. (Not as easy as it sounds.)

(l) Add the capability to handle analogies, maybe like

```
DOGS ARE LIKE CATS EXCEPT DOGS SAY "WOOF"
INSTEAD OF "MEOW"
```

This can make explaining some distinctions easier. Or develop a program to find analogies in property list structures; often you can get insights about the things represented. ☐

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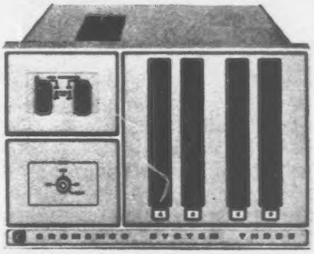

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CIRCLE 211 ON READER SERVICE CARD

Improving the USR Function

David Tilton

Level II Basic on the TRS-80 has the USR function that permits the Basic program to call a machine language subroutine. Considering the many machine language subroutines for the Z-80 and for the 8080 that have been published in magazines and books, this appears to open many exciting possibilities. The initial enthusiasm for the USR function tends to fade when it is discovered that the machine language subroutine must usually be written specially for the USR function in order to couple to the Basic program. A further limitation is that there is only one USR function in Level II Basic, (ten in Disk Basic), so that if more than one subroutine is used, the address of the new subroutine must be POKEd into place each time a different subroutine is called.

The simplest way to tell the subroutine where to find the data is to use the argument of the USR function.

The USR function accepts one integer type argument and returns one integer type value. To get the argument, however, the called subroutine must in turn call a subroutine in ROM which loads the argument into the HL register pair. To return a value from the HL registers, the subroutine must jump to an address in ROM instead of ending with the usual return instruction. The only officially suggested method of transmitting more than one value is to POKE it one byte at a time into some sort of buffer where the subroutine can find it and to read it back by using the PEEK function. Compared to machine language transfers, this POKEing and PEEKing from Basic is painfully slow and is further slowed by the necessary conversion of the data from Basic variables into one-byte integers and back to Basic variable form. It seemed to me that there must be a better way, so I started to analyze that situation. I think that I have found a better way.

It occurred to me that if there were some method of easily transmitting information from the Basic program to a subroutine, it would be possible to write a subroutine that would take care of loading the data into the registers and then call the selected subroutine. Upon return from the selected subroutine it could move the data returned in the registers to the Basic variables and then return to Basic. The problem then is how to give the subroutine access to the Basic variables. Since the Basic variable values are stored somewhere in memory, the subroutine has access to them if it can find them. There are two possible ways of having the subroutine find the variables. Either it could be told where to find them or it could be told how to recognize them and let it search for them. Either method is possible but the first is the easiest. The simplest way to tell the subroutine where to find the data is to use the argument of the USR function. This is a two-byte integer and is just sufficient to transmit one address. We must therefore put all the data in one place so that one address is enough. This can be done in the Basic program by using an integer array. An integer array is used because integer values are easily loaded into the registers, but any other numeric variable type would have to be translated into integer values to be loaded and the only string form likely to be loaded into registers is a one character string loaded as one byte. The STR$ and ASC functions make it easy to translate these to and from integer values. The VARPTR function is used to get the address of the array to transmit as the argument of the USR function.

For Level II the addresses are given in decimal form. For addresses up to 32767 (the highest memory address in a 16K machine) there is no problem, but once the expansion interface and additional memory are installed, there is a problem getting the addresses above 32767 into integer form. Two byte integers are stored in memory with the low-order byte first and then the high-order byte. Machine language addresses are stored in exactly the same way. But the interpretation of the sixteen bits is different. Machine language addresses are interpreted as simple 16-bit binary numbers,which allows for a range of 0-65535. Basic interprets the same 16-bit patterns by the twos-complement convention which gives a range of -32768 to +32767. Numbers in the range 0 to +32767 are interpreted in exactly the same way by both systems. This range uses the first fifteen bits only,leaving the sixteenth bit a 0. The simple binary interpretation assigns a value of +32768 to this 16th bit while the twos compliment convention assigns a value of -32768 to the 16th bit. When addresses above 32767 are put into integer form in Basic, it is necessary to give a negative value exactly 65536 lower than the actual address to create the bit pattern that machine language will interpret correctly. (The same goes for addresses in the POKE statement and the PEEK function). The VARPTR function on the other hand returns values as single precision so that it can handle values over 32767. In giving addresses for memory size, or for starting addresses under the system mode no conversion to negative numbers is necessary or allowed.

Compared to machine language transfers, POKEing and PEEKing from Basic is painfully slow.

There is another problem of which you should be aware. Under some circumstances it is possible for an array to move in memory! The memory map in the Level II

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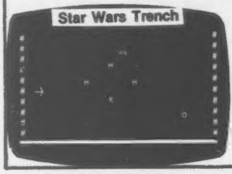

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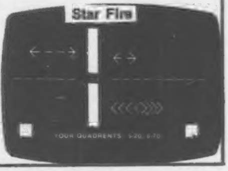

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manual shows that array memory space is located just above the simple (non-array) variable space. The TRS-80 does not assign memory space to a variable until a value is assigned to the variable by the program. Whenever a simple variable is first assigned a value and has memory space assigned to it, it is necessary to expand the simple variable memory area, and the array memory area with all of the arrays in it is moved up in memory to make room. If this happens between using the VARPTR function to get the array address and using the address as the argument of the USR function, weird things can happen when the subroutine uses whatever happens to be where the array used to be as data. There are two methods of avoiding this problem. If it is certain that the address of the array is not above 32767, then write the USR function call this way:

USR(VARPTR(DA%(0))).

The other way is to assign values to all of the simple variables, or at least those appearing between the VARPTR call and the USR call, before the first VARPTR call.

Under some circumstances it is possible for an array to move in memory.

I have written a subroutine called USRLNK which operates as outlined above. It is called USRLNK because it links a more general class of subroutine to the USR function. This program was assembled and listed using the Radio Shack Editor/Assembler program. (See Listing A). It requires an integer array, say DA%, of dimension at least DA%(8), and a simple integer variable, say FR%. In the Basic program DA% could be dimensioned with a statement such as 20DIM DA% (8), or left undimensioned which would reserve elements up to DA%(10) and waste four bytes of memory. But would they be wasted? DA%(8) in the dimension statement, would require six bytes of memory for program storage, even if a dimension statement was necessary anyway for other purposes!

```
               00100 ;************************
               00110 ;* SUBROUTINE USRLNK *
               00115 ;*  BY: D. S. TILTON *
               00120 ;************************
               00130 ;CALLING SEQUENCE FROM BASIC:
               00140 ;ESTABLISH ARRAY DA% IN BASIC PROGRAM
               00150 ;MINIMUM DIMENSION DA%(8)
               00160 ;(THE NAME OF THE ARRAY IS OPTIONAL)
               00170 ;IN BASIC LOAD THE ARRAY AS FOLLOWS:
               00180 ; DA%(0)=ADDRESS OF SUBROUTINE
               00190 ; DA%(1)=HL VALUE ON ENTRY
               00200 ; DA%(2)=DE VALUE ON ENTRY
               00210 ; DA%(3)=BC VALUE ON ENTRY
               00220 ; DA%(4)=A  VALUE ON ENTRY (0 TO 255)
               00230 ;USR CALL AS FOLLOWS: FR%=USR(VARPTR(DA%(0)))
               00240 ;RETURNED VALUES:
               00250 ;DA%(5)=HL VALUE ON RETURN
               00260 ;DA%(6)=DE VALUE ON RETURN
               00270 ;DA%(7)=BC VALUE ON RETURN
               00280 ;DA%(8)=A  VALUE ON RETURN
               00290 ;FR%=FLAG REGISTER ON RETURN
               00300 ;
7F00           00310        ORG     7F00H
7F00 0000      00320 ARYADD DEFW    0000H
7F02 CD7F0A    00330 USRLNK CALL    0A7FH        ;GET ARRAY ADDRESS
7F05 22007F    00340        LD      (ARYADD).HL  ;SAVE ARRAY ADDRESS
7F08 DD2A007F  00350        LD      IX.(ARYADD)  ;LOAD IX WITH ARRAY ADD.
7F0C DD6E00    00360        LD      L.(IX)       ;GET SUBROUTINE ADDRESS
7F0F DD6601    00370        LD      H.(IX+1)     ;FROM DA%(0)
7F12 E5        00380        PUSH    HL           ;AND MOVE IT
7F13 FDE1      00390        POP     IY           ;TO IY
7F15 DD6E02    00400        LD      L.(IX+2)     ;LOAD HL
7F18 DD6603    00410        LD      H.(IX+3)     ;FROM DA%(1)
7F1B DD5E04    00420        LD      E.(IX+4)     ;LOAD DE
7F1E DD5605    00430        LD      D.(IX+5)     ;FROM DA%(2)
7F21 DD4E06    00440        LD      C.(IX+6)     ;LOAD BC
7F24 DD4607    00450        LD      B.(IX+7)     ;FROM DA%(3)
7F27 DD7E08    00460        LD      A.(IX+8)     ;LOAD A FROM DA%(4)
7F2A CD507F    00470        CALL    SRJPIY       ;CALL SUBROUTINE
7F2D DD2A007F  00480        LD      IX.(ARYADD)  ;GET ARRAY ADD. INTO IX
7F31 DD750A    00490        LD      (IX+10).L    ;LOAD DA%(5)
7F34 DD740B    00500        LD      (IX+11).H    ;FROM HL
7F37 DD730C    00510        LD      (IX+12).E    ;LOAD DA%(6)
7F3A DD720D    00520        LD      (IX+13).D    ;FROM DE
7F3D DD710E    00530        LD      (IX+14).C    ;LOAD DA%(7)
7F40 DD700F    00540        LD      (IX+15).B    ;FROM BC
7F43 DD7710    00550        LD      (IX+16).A    ;LOAD DA%(8) FROM A
7F46 3E00      00560        LD      A.00H        ;CLEAR A
7F48 DD7711    00570        LD      (IX+17).A    ;CLEAR MSB OF DA%(8)
7F4B F5        00580        PUSH    AF           ;MOVE FLAGS
7F4C E1        00590        POP     HL           ;INTO HL TO
7F4D C39A0A    00600        JP      0A9AH        ;RETURN AS USR VALUE
7F50 FDE9      00610 SRJPIY JP      (IY)         ;CALL SRJPIY = CALL (IY)
               00620 ;********************
               00630 ;* PROGRAM USRADL *
               00640 ;********************
               00650 ;FOR LEVEL II USE ONLY
               00660 ;THIS LOADS USRLNK ADDRESS FOR USR FUNCTION
7F52 21027F    00670 USRADL LD      HL.USRLNK    ;GET USRLNK ADDRESS IN HL
7F55 228E40    00680        LD      (16526).HL   ;LOAD ADDRESS FOR USR
7F58 C3191A    00690        JP      1A19H        ;RETURN TO BASIC READY
7F52           00700        END     USRADL
00000 TOTAL ERRORS
USRADL  7F52
SRJPIY  7F50
USRLNK  7F02
ARYADD  7F00
```

The array should be loaded as follows:

DA%(0)=Subroutine Address.
DA%(1)=HL value on entry.
DA%(2)=DE value on entry.
DA%(3)=BC value on entry.
DA%(4)=A value on entry. (0 to 225)

Then USR could be called as:

FR%=USR(VARPTR(DA%(0))).

on return from the subroutine:

DA%(5) contains the returned HL value.
DA%(6) contains the returned DE value.
DA%(7) contains the returned BC value.
DA%(8) contains the returned A value.
and FR% contains the flag register.

If there is any possibility that the address of the array is above the 32767 then the USR call should be made like this:

```
A=0:A%=0
A=VARPTR(DA%(0)): IF A>32767 THEN
  A%=A-65536 ELSE A%=A
FR%=USR(A%)
```

Perhaps you are wondering why the returned values were not put back in DA%(1) through DA%(4). This could have been done very easily, but sometimes the same subroutine must be called often and with the same values each time. By using a separate array for this purpose, elements 0 through 4 of this array could be loaded once and several calls made without any reloading. Since one of the reasons for using subroutines is to save time, the time saved by not having to reload the array could be important.

I have included on the same listing with USRLNK a brief program called USRADL which loads the address of USRLNK into the proper place in memory and then jumps to a READY in Basic. The address of USRADL is given as the starting address on the listing. This is of use only with Level II Basic. For Disk Basic, a DEFUSR statement must be used instead.

The time saved by not having to reload the array could be important.

USRLNK should work with most subroutines since it loads registers A, BC, DE, and HL and returns all of these registers plus the flags. □

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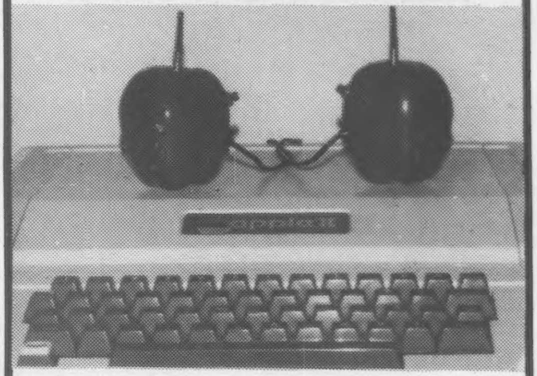

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Divide N-Conquer

John E. Bailey

For many of us, the hardest part of programming is developing the algorithms needed to perform the tasks that will produce the desired results. Presented here is the development of an algorithm to perform long division. Although it may not be very useful for more than demonstration purposes, the technique presented here may be helpful in developing more complex and meaningful algorithms.

One of the things that makes a computer so powerful is its ability to perform a given function many many times. We can use this capability with the example above and develop a program to perform long division.

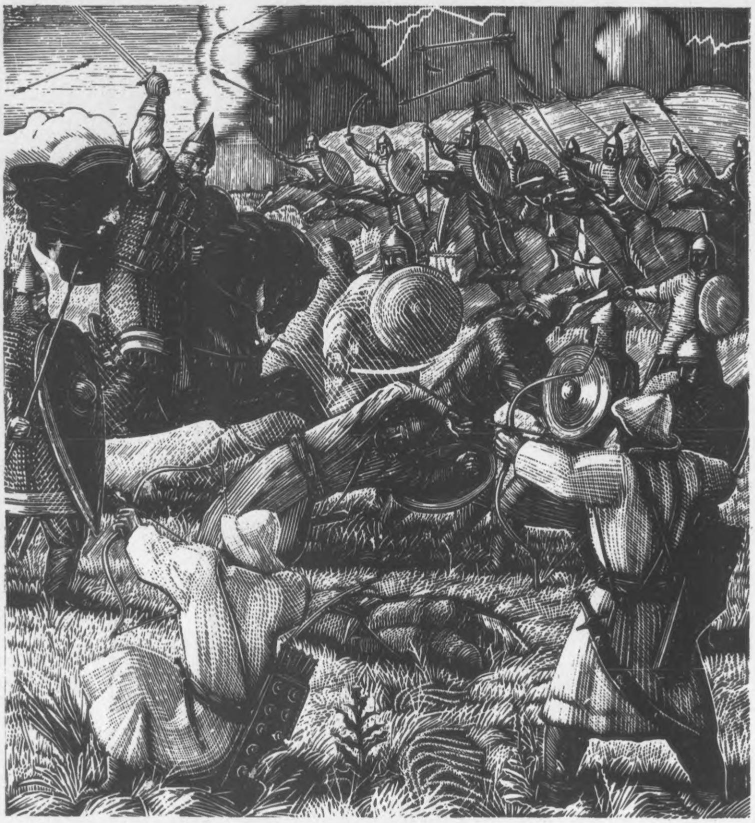
Consider the two integers A = 7 and B = 3. If we divide A by B we get 2.333333. Depending upon the accuracy of our Basic, the result may be carried out to 6 or more digits. This amount of accuracy is generally all that is necessary. But even so, the degree of accuracy can be improved by using the long division technique that is taught in grade school. For example:

```
      2.333333------
3 | 7.000000
    6
    --
    10
     9
    --
    10
     9
```

This process can continue for as many digits as desired. In this example, 3 is called the divisor, 7 is called the dividend, and 2.333333--- is called the quotient. Dividing 7 by 3 gives a quotient of 2 with a remainder of 1. The remainder is then multiplied by 10. This result becomes the new dividend, and the division process continues.

One of the things that makes a computer so powerful is its ability to perform a given function many many times. We can use this capability with the example above and develop a program to perform long division. To do this, we need to develop an algorithm to simulate long division. This is where programmers sometimes bog down and quit. But the process is really very simple if it is approached in a logical fashion. Let's return to the original example. We let A = 7 be the dividend and B = 3 be the divisor. We will also let C be the quotient and R be the remainder. Now,

John E. Bailey, 1108 Post Oak #1, Sulphur, LA 70663.



```
10 INPUT "ENTER VALUE FOR DIVIDEND A =",A
20 INPUT "ENTER VALUE FOR DIVISOR B =",B
30 INPUT "ENTER VALUE FOR NUMBER OF DECIMAL PLACES N =",N
40 LET C=INT(A/B)
50 PRINT A," /",B;" =",C,".",
60 FOR I=1 TO N
70 LET R=A-(B*C)
80 LET A=R*10
90 LET C=INT(A/B)
100 PRINT C,
110 NEXT I
120 END

RUN

ENTER VALUE FOR DIVIDEND A =7
ENTER VALUE FOR DIVISOR B =3
ENTER VALUE FOR NUMBER OF DECIMAL PLACES N = 25
 7 / 3 = 2. 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3


RUN

ENTER VALUE FOR DIVIDEND A =67344
ENTER VALUE FOR DIVISOR B =9024
ENTER VALUE FOR NUMBER OF DECIMAL PLACES =350
 67344 / 9024 = 7. 4 6 2 7 6 5 9 5 7 4 4 6 8 0 8 5 1 0 6 3 8 2 9 7 8 7 2
 3 4 0 4 2 5 5 3 1 9 1 4 8 9 3 6 1 7 0 2 1 2 7 6 5 9 5 7 4 4 6 8 0 8 5 1
 0 6 3 8 2 9 7 8 7 2 3 4 0 4 2 5 5 3 1 9 1 4 8 9 3 6 1 7 0 2 1 2 7 6 5 9
 5 7 4 4 6 8 0 8 5 1 0 6 3 8 2 9 7 8 7 2 3 4 0 4 2 5 5 3 1 9 1 4 8 9 3 6
 1 7 0 2 1 2 7 6 5 9 5 7 4 4 6 8 0 8 5 1 0 6 3 8 2 9 7 8 7 2 3 4 0 4 2 5
 5 3 1 9 1 4 8 9 3 6 1 7 0 2 1 2 7 6 5 9 5 7 4 4 6 8 0 8 5 1 0 6 3 8 2 9
 7 8 7 2 3 4 0 4 2 5 5 3 1 9 1 4 8 9 3 6 1 7 0 2 1 2 7 6 5 9 5 7 4 4 6 8
 0 8 5 1 0 6 3 8 2 9 7 8 7 2 3 4 0 4 2 5 5 3 1 9 1 4 8 9 3 6 1 7 0 2 1 2
 7 6 5 9 5 7 4 4 6 8 0 8 5 1 0 6 3 8 2 9 7 8 7 2 3 4 0 4 2 5 5 3 1 9 1 4
 8 9 3 6 1 7 0 2 1 2 7 6 5 9 5 7 4 4 6 8 0 8 5 1 0 6 3 8 2 9 7 8 7 2 3
```

Figure 1

Programming a computer is

childs
PLAY

Hey Kids, are the folks out of the room? Good, 'cause I've got a secret to tell you. You know that computer they fuss over? Well, kid, between you and me, this whole programming thing is a lot simpler than they realize.

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Robert Taylor, Director of the Program in Computing and Education at Teachers College, Columbia University states, "it's a good idea to have a book *for children*."

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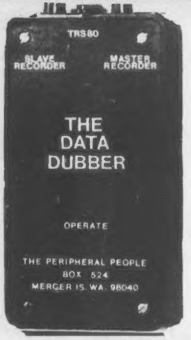

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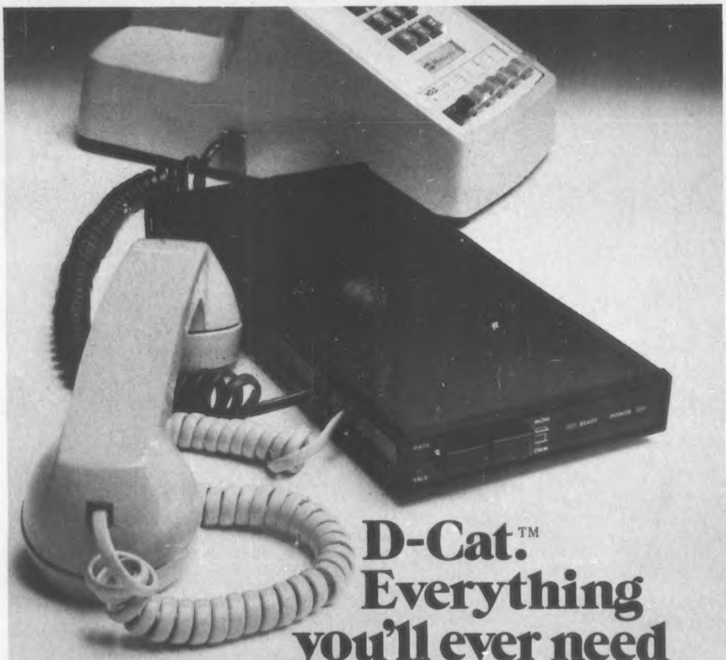

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CIRCLE 197 ON READER SERVICE CARD

Divide, cont'd...

```
      C
B  |  A
      B*C
   ----------
      A-(B*C)*10
```

Here we divide the dividend A by the divisor B and get the quotient C. Following the procedure used in the example, we then multiply B times C; then subtract that product from A to get the remainder A-(B*C); then multiply the remainder by 10 to get the new dividend A-(B*C)*10. The process then begins to repeat itself. This repetition can continue for as many times as we want it to.

Now let's develop a program that implements the algorithm to simulate long division. The first thing to do is to define the variables.

```
10 LET A=7
20 LET B=3
30 LET N=25
```

Here again, A is the dividend, B is the divisor, and N is the number of times we want to repeat the division, i.e., the number of digits we want to the right of the decimal. Next, define the initial quotient and print that result.

```
40 LET C=INT(A/B)
50 PRINT C,".",
```

Now set up a For/Next loop to perform the process N number of times.

```
60 FOR I=1 TO N
```

Now implement the algorithm developed earlier.

```
 70 LET R=A-(B*C)
 80 LET A=R*10
 90 LET C=INT(A/B)
100 PRINT C,
110 NEXT I
120 END
```

Line 70 computes the remainder. Line 80 multiplies the remainder by 10 and replaces the old dividend with the new dividend. Line 90 computes the new quotient and Line 100 prints it. The process continues N number of times.

The technique shown here in developing the long division algorithm may be used in developing much more complex ones. The method is simple. Define your variables. Define how they interact with each other by using an example. Define the intermediate results and logically make them produce the final result.

The program presented here makes an interesting demo. Lines 10, 20 and 30 should be changed to input statements so that the variables A, B and N can be made any desired values. Explain to your friends what the program does, plug in some values, and watch the result fly across the screen.

It should be emphasized that the values for A, B and N must be integers. Figure 1 shows the fully developed program and a run example. ☐

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CIRCLE 221 ON READER SERVICE CARD

Unlimited Precision Division for Real Number Basic

Pat Fitzgerald

In computer division the result is expressed in one of two ways, either as a real number or a real number multiplied by a power of 10. The transition from one form to the other is dependent on the size of the computer word. However, by suitable programming, it is possible to divide two numbers and obtain all digits of the answer provided that neither the divisor nor the dividend are greater than the computer's power to express numbers without going into exponential notation. This article describes a simple method to do this using Basic.

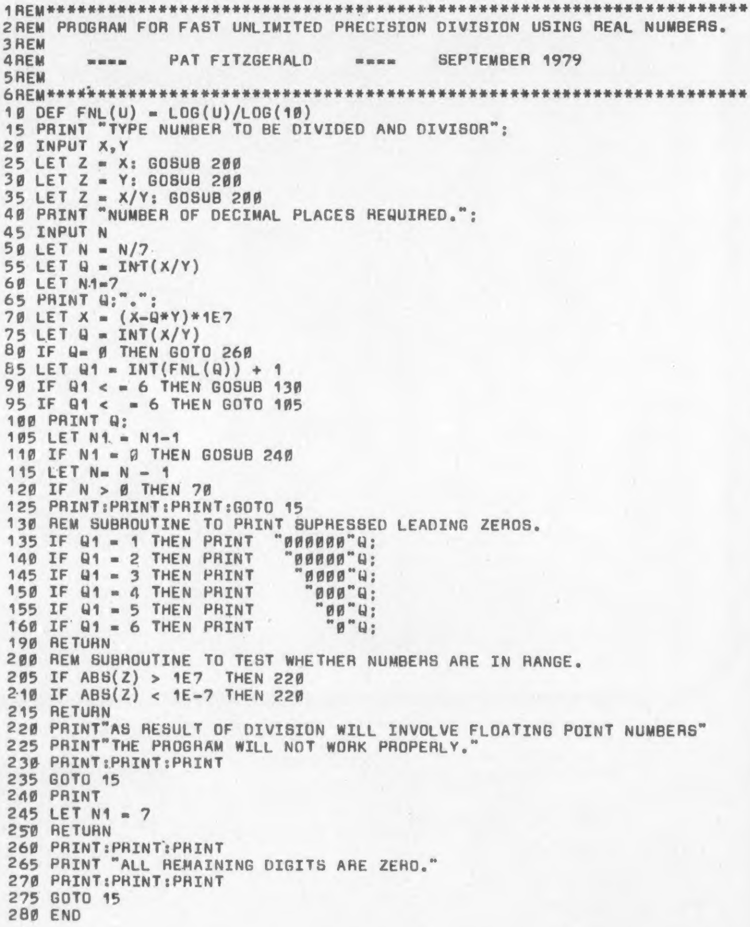
To fix ideas, the program has been written for a PDP 11/10 minicomputer which can express numbers in the range 1 E - 7 to 1 E 7 without using exponential notation. The program has obvious modifications to suit other versions of Basic. After asking for the number to be divided and the divisor, the program checks to see if the numbers and initial division are within the required range, this is achieved in lines 25 to 30 through the subroutine in lines 200 to 215. Line 40 requests the number of decimal places and, as the program produces these numbers in groups of 7, the number input is divided by 7. Each successive division is tested in line 80 to see if the result is equal to zero. If it is the program prints the message in line 260.

Practically all versions of Basic suppress leading zeros, so if the division is to produce the correct result the program must supply these.

The number of each division after the first is checked to see how many digits it has by calculating the logarithm to base 10 of the number by the use of the function defined in line 10, the integer value of this is taken and one added to it. This gives the number of digits in the answer. If the answer is less than or equal to 6, the subroutine in line 130 is called up to print the suppressed zeros. After each division the program returns to line 15 for another run. The best printout on our machine is 7 groups of 7, any more and untidy printing results with groups being split between lines. For this reason the number N1 in line 60 is decremented by one each time a group is printed. When it reaches zero a new line is called and N1 set to 7 by the subroutine in line 240. The program is given in Listing 1 and examples of its output are given in Listing 2. ☐

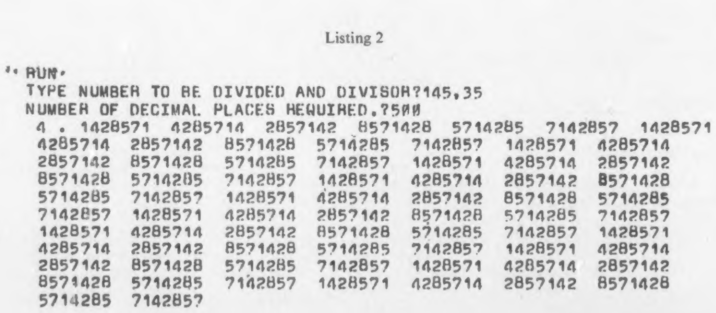
Pat Fitzgerald, Winchmore Irrigation Research Station, Private Bag, Ashburton, New Zealand.

Listing 1



```
1REM*********************************************************************
2REM PROGRAM FOR FAST UNLIMITED PRECISION DIVISION USING REAL NUMBERS.
3REM
4REM    ----    PAT FITZGERALD    ----    SEPTEMBER 1979
5REM
6REM*********************************************************************
10 DEF FNL(U) = LOG(U)/LOG(10)
15 PRINT "TYPE NUMBER TO BE DIVIDED AND DIVISOR";
20 INPUT X,Y
25 LET Z = X: GOSUB 200
30 LET Z = Y: GOSUB 200
35 LET Z = X/Y: GOSUB 200
40 PRINT "NUMBER OF DECIMAL PLACES REQUIRED.";
45 INPUT N
50 LET N = N/7
55 LET Q = INT(X/Y)
60 LET N1=7
65 PRINT Q;".";
70 LET X = (X-Q*Y)*1E7
75 LET Q = INT(X/Y)
80 IF Q= 0 THEN GOTO 260
85 LET Q1 = INT(FNL(Q)) + 1
90 IF Q1 < = 6 THEN GOSUB 130
95 IF Q1 <  = 6 THEN GOTO 105
100 PRINT Q;
105 LET N1 = N1-1
110 IF N1 = 0 THEN GOSUB 240
115 LET N= N - 1
120 IF N > 0 THEN 70
125 PRINT:PRINT:PRINT:GOTO 15
130 REM SUBROUTINE TO PRINT SUPRESSED LEADING ZEROS.
135 IF Q1 = 1 THEN PRINT  "000000"Q;
140 IF Q1 = 2 THEN PRINT   "00000"Q;
145 IF Q1 = 3 THEN PRINT    "0000"Q;
150 IF Q1 = 4 THEN PRINT     "000"Q;
155 IF Q1 = 5 THEN PRINT      "00"Q;
160 IF Q1 = 6 THEN PRINT       "0"Q;
190 RETURN
200 REM SUBROUTINE TO TEST WHETHER NUMBERS ARE IN RANGE.
205 IF ABS(Z) > 1E7  THEN 220
210 IF ABS(Z) < 1E-7 THEN 220
215 RETURN
220 PRINT"AS RESULT OF DIVISION WILL INVOLVE FLOATING POINT NUMBERS"
225 PRINT"THE PROGRAM WILL NOT WORK PROPERLY."
230 PRINT:PRINT:PRINT
235 GOTO 15
240 PRINT
245 LET N1 = 7
250 RETURN
260 PRINT:PRINT:PRINT
265 PRINT "ALL REMAINING DIGITS ARE ZERO."
270 PRINT:PRINT:PRINT
275 GOTO 15
280 END
```

Listing 2



```
'' RUN'
   TYPE NUMBER TO BE DIVIDED AND DIVISOR?145,35
   NUMBER OF DECIMAL PLACES REQUIRED.?500
    4 . 1428571  4285714  2857142  8571428  5714285  7142857  1428571
    4285714  2857142  8571428  5714285  7142857  1428571  4285714
    2857142  8571428  5714285  7142857  1428571  4285714  2857142
    8571428  5714285  7142857  1428571  4285714  2857142  8571428
    5714285  7142857  1428571  4285714  2857142  8571428  5714285
    7142857  1428571  4285714  2857142  8571428  5714285  7142857
    1428571  4285714  2857142  8571428  5714285  7142857  1428571
    4285714  2857142  8571428  5714285  7142857  1428571  4285714
    2857142  8571428  5714285  7142857  1428571  4285714  2857142
    8571428  5714285  7142857  1428571  4285714  2857142  8571428
    5714285  7142857
```

Division, cont'd...

```
TYPE NUMBER TO BE DIVIDED AND DIVISOR?20,2
NUMBER OF DECIMAL PLACES REQUIRED.?49
 10 .

ALL REMAINING DIGITS ARE ZERO.

TYPE NUMBER TO BE DIVIDED AND DIVISOR?25,13
NUMBER OF DECIMAL PLACES REQUIRED.?98
 1 . 9230769  2307692  3076923 0 769230  7692307  6923076  9230769
 2307692  3076923 0 769230  7692307  6923076  9230769  2307692

TYPE NUMBER TO BE DIVIDED AND DIVISOR?123456789,12
AS RESULT OF DIVISION WILL INVOLVE FLOATING POINT NUMBERS
THE PROGRAM WILL NOT WORK PROPERLY.

TYPE NUMBER TO BE DIVIDED AND DIVISOR?.001,12
NUMBER OF DECIMAL PLACES REQUIRED.?49
 0 .0000 833  3333326  9765625

ALL REMAINING DIGITS ARE ZERO.

TYPE NUMBER TO BE DIVIDED AND DIVISOR?123,321
NUMBER OF DECIMAL PLACES REQUIRED.?49
 0 . 3831775  7009345  7912772  5856697  8193146  4174454  8286604

TYPE NUMBER TO BE DIVIDED AND DIVISOR?1,3227
NUMBER OF DECIMAL PLACES REQUIRED.?56
 0 .000 3098  8534242  3321970  8701580  4164859 00 24790  8273938
 6445615

TYPE NUMBER TO BE DIVIDED AND DIVISOR?1971,9791
NUMBER OF DECIMAL PLACES REQUIRED.?28
 0 . 2013073  2304156  8791747  5229292

TYPE NUMBER TO BE DIVIDED AND DIVISOR?1979,9791
NUMBER OF DECIMAL PLACES REQUIRED.?28
 0 . 2021244

ALL REMAINING DIGITS ARE ZERO.
```

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CIRCLE 186 ON READER SERVICE CARD

BIGNUMS

Robert A. Howell

Recently, articles have appeared in *Creative Computing* concerning the calculation of multiple precision numbers such as factorials, etc. The one thing usually lacking in such articles is that they never tell you how to say these large numbers in English. This program, appropriately entitled "BIGNUMS," takes a large number and prints out the English words to use in order to pronounce it properly! This allows computer users to express the results of their multiple-precision programs in a much more warm and friendly manner.

You will also notice that the program prints at random a different exclamation with each number that is entered. Anyone armed with a dictionary and a little time and patience can produce a fairly long list of synonyms from which words and expressions can be randomly selected. This makes the output of a program much more interesting. For example, I have a list of about 100 words synonymous with the word fantastic that I put into the game of ARTILLERY-3 from Creative Computing's *More Basic Computer Games.* When my children play the game, they are more interested in what word the computer will print when a hit is made than they are in who scored the hit!

They never tell you how to say these large numbers in English.

The BIGNUMS program is written in Control Data Basic. Here are explanations of some of the statements which may not be familiar to users of other Basic versions:

00390 MARGIN 80

Extends the right-hand margin to character position 80 so that all characters of a multiple line type-in are accepted.

00400 DELIMIT (CR)

Removes blanks and commas from being interpreted as delimiters on input and makes a carriage return the only delimiter recognized. This allows a character string containing blanks and/or commas to be read as a single entire string.

00410 BASE 1

Defines all arrays to start with a subscript of 1 instead of 0.

Various SUBSTR(string,n,m)

Selects a substring from string. The substring is selected starting in string character position n and is m characters long.

01510 RND(-1)

Returns random values greater than 0 but less than 1. A different random sequence is generated each time the program is executed.

Now, let this program begin to teach you how to pronounce large numbers. Then you can really impress your friends, whether they are computer fans or not, and you won't even need a fancy buzzword generator to help you do it! ☐

```
RUN

 79/11/02. 14.17.09.
PROGRAM   BIGNUMS
HI THERE!  MY NAME IS BIGNUMS.  WHAT IS YOUR NAME?
PLEASE ENTER YOUR NAME FOR ME ON THE NEXT LINE.
? BOB

NOW BOB , DO YOU WANT SOME INSTRUCTIONS
ON WHAT TO DO (YES OR NO) ? YES

I CAN TEACH YOU HOW TO SAY BIG NUMBERS, BOB .
TYPE IN ANY POSITIVE WHOLE NUMBER AND I WILL PRINT THE WORDS TO
USE TO SAY THAT NUMBER IN ENGLISH.  YOU MAY USE COMMAS TO
SEPARATE GROUPS OF THREE DIGITS IF YOU WISH, BUT YOU DO NOT HAVE
TO.  FOR EXAMPLE, 1093 AND 1,093 ARE THE SAME NUMBER TO ME.
ONLY THE 10 DIGITS (0 THROUGH 9) AND COMMAS ARE ALLOWED IN THE
NUMBERS YOU TYPE IN.  WHEN YOU WISH TO STOP, TYPE END OR QUIT.

OK, BOB .  ENTER YOUR FIRST NUMBER NOW.
? 1000
THE NUMBER   1,000
      IS SPOKEN IN ENGLISH AS:
            ONE THOUSAND
OK, BOB .  ENTER YOUR SECOND NUMBER NOW.
? 1,000,000,000
HEY BOB , THAT WAS NOT A MEAGER NUMBER!
THE NUMBER   1,000,000,000
      IS SPOKEN IN ENGLISH AS:
            ONE BILLION
OK, BOB .  ENTER YOUR THIRD NUMBER NOW.
? 9,876,543,210
GAD ZOOKS BOB , THAT WAS NOT AN OBSCURE NUMBER!
THE NUMBER   9,876,543,210
      IS SPOKEN IN ENGLISH AS:
            NINE BILLION
            EIGHT HUNDRED SEVENTY SIX MILLION
            FIVE HUNDRED FOURTY THREE THOUSAND
            TWO HUNDRED TEN

OK, BOB .  ENTER YOUR FOURTH NUMBER NOW.
? 100000000001
EUREKA BOB , THAT WAS NOT A TINY NUMBER!
THE NUMBER 100,000,000,001
      IS SPOKEN IN ENGLISH AS:
            ONE HUNDRED BILLION
            ONE
OK, BOB .  ENTER YOUR FIFTH NUMBER NOW.
? QUIT

SBU       1.303 UNTS.

RUN COMPLETE.

LIST

 79/11/02. 14.23.34.
PROGRAM   BIGNUMS

00100 REM THIS PROGRAM ENABLES YOU TO SAY VERRRRRRRY LARGE NUMBERS
      IN ENGLISH!
00110 REM
00120 DATA "ZERO ","ONE ","TWO ","THREE ","FOUR ","FIVE ","SIX ","SEVEN "
00130 DATA "EIGHT ","NINE "
00140 REM
00150 DATA "TEN ","ELEVEN ","TWELVE ","THIRTEEN ","FOURTEEN ","FIFTEEN "
00160 DATA "SIXTEEN ","SEVENTEEN ","EIGHTEEN ","NINTEEN "
00170 REM
00180 DATA "TWENTY ","THIRTY ","FOURTY ","FIFTY ","SIXTY ","SEVENTY "
```

Robert A. Howell, Control Data Corporation, 60 Hickory Drive, Waltham, MA 02154.

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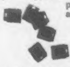
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CIRCLE 224 ON READER SERVICE CARD

```
00190 DATA "EIGHTY ","NINETY "
00200 REM
00210 DATA "HUNDRED","THOUSAND","MILLION","BILLION","TRILLION","QUADRILLION"
00220 DATA "QUINTILLION","SEXTILLION","SEPTILLION","OCTILLION","NONILLION"
00230 DATA "DECILLION","UNDECILLION","DUODECILLION","TREDECILLION"
00240 DATA "QUATTUORDECILLION","QUINDECILLION","SEXDECILLION"
00250 DATA "SEPTENDECILLION","OCTODECILLION","NOVEMDECILLION","VIGINTILLION"
00260 DATA "VIGINTIUNTILLION","VIGINTIDUOTILLION","VIGINTITRETILLION"
00270 DATA "VIGINTIQUATTOURTILLION","VIGINTIQUINTILLION","VIGINTISEXTILLION"
00280 DATA "VIGINTISEPTILLION","VIGINTIOCTILLION","VIGINTINONILLION"
00290 DATA "TRIGINTATILLION","TRIGINTAUNTILLION","TRIGINTADUOTILLION"
00300 REM
00310 DATA "FIRST","SECOND","THIRD","FOURTH","FIFTH","SIXTH","SEVENTH"
00320 DATA "EIGHTH","NINTH","TENTH","ELEVENTH","TWELFTH","THIRTEENTH"
00330 DATA "FOURTEENTH","FIFTEENTH","SIXTEENTH","SEVENTEENTH","EIGHTEENTH"
00340 DATA "NINTEENTH","TWENTIETH","NEXT"
00350 REM
00360 REM ******************************************************************
00370 REM PERFORM PROGRAM INITIALIZATION
00380 REM
00390 MARGIN 80
00400 DELIMIT (CR)
00410 BASE 1
00420 DIM W$(101),W1$(10),W2$(10),W3$(8),W4$(34),W5$(21),W6$(36),W7$(74)
00430 REM
00440 MAT READ W1$, W2$, W3$, W4$, W5$, W6$, W7$
00450 C = 0
00460 REM
00470 REM ******************************************************************
00480 REM EXCHANGE INTRODUCTIONS
00490 REM
00500 I = 0
00510 PRINT
00520 PRINT "HI THERE!  MY NAME IS BIGNUMS.  WHAT IS YOUR NAME?"
00530 PRINT "PLEASE ENTER YOUR NAME FOR ME ON THE NEXT LINE."
00540 INPUT A1$
00550 J = LEN(A1$)
00560 IF J <= 25 GOTO 00670
00570 IF I <> 0 GOTO 00650
00580 PRINT
00590 PRINT "SORRY "; A1$; ","
00600 PRINT "BUT I GET TIRED EASILY SAYING LONG NAMES.";
00610 PRINT " LONG NUMBERS ARE MY THING, YOU KNOW."
00620 PRINT "PLEASE RETYPE YOUR NAME NOW AND LIMIT IT TO 25 SPACES OR LESS."
00630 I = 1
00640 GOTO 00540
00650 A1$ = SUBSTR(A1$,1,25)
00660 GOTO 00690
00670 IF I = 0 GOTO 00690
00680 PRINT "WHEW, THANK YOU "; A1$; "!  THAT'S MUCH BETTER."
00690 PRINT
00700 REM
00710 REM ******************************************************************
00720 REM SEE IF INSTRUCTIONS ARE NEEDED
00730 REM
00740 PRINT "NOW "; A1$; ", DO YOU WANT SOME INSTRUCTIONS"
00750 PRINT "ON WHAT TO DO (YES OR NO)";
00760 INPUT A$
00770 IF SUBSTR(A$,1,1) = "N" GOTO 00910
00780 IF SUBSTR(A$,1,1) <> "Y" GOTO 00740
00790 PRINT
00800 PRINT "I CAN TEACH YOU HOW TO SAY BIG NUMBERS, "; A1$; "."
00810 PRINT "TYPE IN ANY POSITIVE WHOLE NUMBER AND I WILL PRINT THE WORDS TO"
00820 PRINT "USE TO SAY THAT NUMBER IN ENGLISH.  YOU MAY USE COMMAS TO"
00830 PRINT "SEPARATE GROUPS OF THREE DIGITS IF YOU WISH, BUT YOU DO NOT HAVE"
00840 PRINT "TO.  FOR EXAMPLE, 1093 AND 1,093 ARE THE SAME NUMBER TO ME."
00850 PRINT "ONLY THE 10 DIGITS (0 THROUGH 9) AND COMMAS ARE ALLOWED IN THE"
00860 PRINT "NUMBERS YOU TYPE IN.  WHEN YOU WISH TO STOP, TYPE END OR QUIT."
00870 REM
00880 REM **************************************************************
00890 REM GET THE NEXT NUMBER
00900 REM
00910 PRINT
00920 C = C + 1
00930 IF C <= 21 GOTO 00950
00940 C = 21
00950 PRINT "OK, "; A1$; ".  ENTER YOUR "; W5$(C); " NUMBER NOW."
00960 INPUT I$
00970 IF SUBSTR(I$,1,3) = "END" GOTO 02860
00980 IF SUBSTR(I$,1,4) = "QUIT" GOTO 02860
00990 REM
01000 REM **************************************************************
01010 REM PERFORM SOME VALIDITY CHECKS
01020 REM     CHECK THAT ONLY DIGITS, COMMAS AND BLANKS WERE TYPED IN
01030 REM     DISCARD ALL BLANKS AND ALL LEADING ZEROS
01040 REM     PUT DIGITS INTO MATRIX W$, ONE DIGIT PER MATRIX ELEMENT
01050 REM     COUNT THE NUMBER OF DIGITS (MAXIMUM IS 101)
01060 REM
01070 L = LEN(I$)
01080 N = 0
01090 G = 0
01100 Z = 1
01110 FOR J = 1 TO L
01120 D$ = SUBSTR(I$,J,1)
01130 IF D$ = "," GOTO 01220
01140 IF D$ = " " GOTO 01220
01150 IF D$ < "0"  OR  D$ > "9"  GOTO 01410
01160 ON Z GOTO 01170 , 01190
01170 IF D$ = "0" GOTO 01220
01180 Z = 2
01190 N = N + 1
01200 IF N > 101 GOTO 02350
01210 W$(N) = D$
01220 NEXT J
01230 REM
01240 IF N > 0 GOTO 01280
01250 REM CHECK FOR THE NUMBER ZERO
01260 N = 1
01270 W$(N) = "0"
01280 IF N <> 101 GOTO 01500
01290 REM CHECK FOR A GOOGOL (1 FOLLOWED BY 100 ZEROS).  A GOOGOL IS THE
01300 REM LARGEST NUMBER THIS PROGRAM CAN HANDLE.  SET GOOGOL FLAG IF FOUND.
01310 IF W$(1) <> "1" GOTO 02350
01320 FOR J = 2 TO N
01330 IF W$(J) <> "0" GOTO 02350
01340 NEXT J
01350 G = 1
01360 GOTO 01500
01370 REM
01380 REM ******************************************************************
01390 REM INVALID NUMBER TYPED IN.  SCOLD, THEN GIVE ANOTHER CHANCE.
01400 REM
01410 PRINT "SORRY "; A1$; " BUT THE NUMBER YOU ENTER MUST CONTAIN ONLY"
01420 PRINT "DIGITS 0 THROUGH 9 AND COMMAS - NO OTHER LETTERS OR CHARACTERS."
01430 PRINT "PLEASE REENTER YOUR "; W5$(C); " NUMBER CORRECTLY NOW."
01440 GOTO 00960
01450 REM
01460 REM ******************************************************************
01470 REM EXCLAIM SOMETHING DIFFERENT ABOUT THE NUMBER NOW IF IT IS AT LEAST
01480 REM A BILLION!
01490 REM
01500 IF N <= 9 GOTO 01580
01510 I = INT((RND(-1)*36)+1)
01520 J = INT((RND(-1)*74)+1)
01530 PRINT W6$(I); " "; A1$; ", THAT WAS "; W7$(J); " NUMBER!"
01540 REM
```

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In **Air Traffic Controller** you assume responsibility for the safe flow of air traffic within a 15x25 mile area up to 5,000 feet in altitude. During your shift as a controller in charge of this airspace, 26 aircraft become active and under your control. Jets and prop planes have to be guided to and from the two airports, navigational beacons and ten entry/exit fixes. The aircraft enter the controller's airspace at various altitudes and headings whether or not you are ready.

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The most obvious measure of difficulty of a game is the clock setting at the beginning. In a 99 minute game you will have time to go fix a sandwich between the appearance of two successive aircraft, while in the 16 minute game you may not have time to swallow before all of the aircraft have appeared.

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BIGNUMS, cont'd...

```
01550 REM ********************************************************************
01560 REM PRINT THE NUMBER WITH COMMAS INSERTED IN THE CORRECT PLACES
01570 REM
01580 N1 = INT((N+2)/3)
01590 N2 = ((N1*3)+1)-N
01600 PRINT "THE NUMBER ";
01610 J = 11
01620 ON N2 GOTO 01670 , 01650 , 01630
01630 PRINT " ";
01640 J = J + 1
01650 PRINT " ";
01660 J = J + 1
01670 FOR I = 1 TO N
01680 ON N2 GOTO 01690 , 01690 , 01690 , 01710
01690 PRINT W$(I);
01700 GOTO 01720
01710 PRINT ",";
01720 J = J + 1
01730 N2 = N2 + 1
01740 IF N2 <= 4 GOTO 01760
01750 N2 = 1
01760 IF J <= 78 GOTO 01810
01770 PRINT
01780 PRINT TAB(11);
01790 J = 11
01800 GOTO 01690
01810 IF N2 = 1 GOTO 01690
01820 NEXT I
01830 PRINT
01840 REM
01850 REM ********************************************************************
01860 REM NOW PRINT THE ENGLISH WORDS TO SAY THE NUMBER, EACH SET OF 3 DIGITS
01870 REM TO ONE LINE
01880 REM
01890 PRINT TAB(5); "IS SPOKEN IN ENGLISH AS: "
01900 IF G = 0 GOTO 01940
01910 PRINT TAB(11); "ONE GOOGOL"
01920 G = 0
01930 GOTO 00910
01940 N2 = ((N1*3)+1)-N
01950 PRINT TAB(11);
01960 F1 = 1
01970 F2 = 0
01980 FOR I = 1 TO N
01990 D = VAL(W$(I))
02000 ON N2 GOTO 02020 , 02080 , 02150
02010 REM DIGIT IS IN THE HUNDREDS POSITION
02020 F2 = F2 + D
02030 IF D = 0 GOTO 02290
02040 PRINT W1$(D+1);
02050 PRINT W4$(1); " ";
02060 GOTO 02290
02070 REM DIGIT IS IN THE TENS POSITION
02080 F2 = F2 + D
02090 ON D+1 GOTO 02290,02100,02120,02120,02120,02120,02120,
      02120,02120,02120
02100 F1 = 2
02110 GOTO 02290
02120 PRINT W3$(D-1);
02130 GOTO 02290
02140 REM DIGIT IS IN THE ONES POSITION
02150 F2 = F2 + D
02160 ON F1 GOTO 02170 , 02220
02170 IF N = 1 GOTO 02200
02180 IF F2 = 0 GOTO 02260
02190 IF D = 0 GOTO 02230
02200 PRINT W1$(D+1);
```

```
02210 GOTO 02230
02220 PRINT W2$(D+1);
02230 IF N1 <= 1 GOTO 02290
02240 PRINT W4$(N1)
02250 PRINT TAB(11);
02260 N1 = N1 - 1
02270 F1 = 1
02280 F2 = 0
02290 N2 = N2 + 1
02300 IF N2 <> 4 GOTO 02320
02310 N2 = 1
02320 NEXT I
02330 PRINT
02340 GOTO 00910 .
02350 PRINT
02360 REM
02370 REM ********************************************************************
02380 REM A NUMBER BIGGER THAN A GOOGUL HAS BEEN ENTERED.  SINCE I CANNOT
02390 REM HANDLE THIS BIG A NUMBER, I WILL GIVE HIM OR HER SOMETHING TO KEEP
02400 REM BUSY WITH - NAMELY, WRITING OUT ALL THE DIGITS IN A GOOGOLPLEX!!!
02410 REM A GOOGOLPLEX IS 1 FOLLOWED BY A GOOGOL NUMBER OF ZEROS OR 10 RAISED
02420 REM TO A GOOGOL POWER WHERE A GOOGOL OF COURSE IS 1 FOLLOWED BY 100
02430 REM ZEROS.  NOTE, IF ONE TRAVELED TO THE FARTHEST STAR WRITING ZEROS
02440 REM ALL THE WAY, THERE WOULD STILL NOT BE ENOUGH SPACE TO WRITE A
02450 REM GOOGOLPLEX!
02460 REM
02470 PRINT "WELL "; A1$; " THAT NUMBER IS BIGGER THAN A GOOGOL (1 FOLLOWED"
02480 PRINT "BY 100 ZEROS).  BEFORE I TELL YOU HOW TO SAY IT, YOU MUST FIRST"
02490 PRINT "SHOW YOURSELF WORTHY.  TAKE A PENCIL AND SOME PAPER AND WRITE"
02500 PRINT "DOWN ALL THE DIGITS IN A GOOGOLPLEX.  A GOOGOLPLEX IS 1 FOLLOWED"
02510 PRINT "BY A GOOGOL NUMBER OF ZEROS.  WHEN YOU HAVE WRITTEN ALL THE"
02520 PRINT "DIGITS IN A GOOGOLPLEX DOWN ON PAPER, COME AND TYPE THEM IN FOR"
02530 PRINT "ME AND THEN I WILL KNOW YOU ARE WORTHY TO SPEAK NUMBERS LARGER"
02540 PRINT "THAN A GOOGOL.  GOOD BYE FOR NOW."
02550 REM
02560 REM ********************************************************************
02570 REM PROGRAM DATA
02580 REM
02590 DATA "AHA","BINGO","BOY","BOY OH BOY","BRAVO","EUREKA","GAD ZOOKS"
02600 DATA "GOLLY","GOSH","HEY","HEY THERE","HO HO","HOORAY","MAMA MIA","MAN"
02610 DATA "OH BOY","OH HO HO HO","OH ME","OH ME OH MY","OH MY","OHO","OH WOW"
02620 DATA "OK","O SOL O MI O","RIGHT ON","WHOOPIE","WILD","WOW","YE GADS"
02630 DATA "YES","YIKES","YIPES","YOW","YOWIE","ZINGO","ZOWIE"
02640 REM
02650 DATA "AN AMPLE","AN AUGUST","A BIG","A BRAWNY","A CAPACIOUS"
02660 DATA "A COMPREHENSIVE","A COLOSSAL","AN ELEPHANTINE","AN ENORMOUS"
02670 DATA "AN EXTENSIVE","A GIGANTIC","A GORGEOUS","A GRAND","A GREAT"
02680 DATA "A HUGE","A HUMONGOUS","AN IMMENSE","A LARGE","A MAGNANIMOUS"
02690 DATA "A MAJESTIC","A MASSIVE","A MIGHTY","A MONSTROUS","A MUSCULAR"
02700 DATA "AN OSTENTATIOUS","A POMPOUS","A POWERFUL","A PRINCELY"
02710 DATA "A PRODIGIOUS","A REGAL","A SIGNIFICANT","A SOPHISTICATED"
02720 DATA "A SPACIOUS","A SPLENDID","A STUPENDOUS","A SUPERB","A VAST"
02730 DATA "A WIDE"
02740 REM
02750 DATA "NOT YOUR AVERAGE", "NOT YOUR COMMON", "NOT YOUR COMMONPLACE"
02760 DATA "NOT A CRAMPED", "NOT A DWARF OF A", "NOT AN ELEMENTARY"
02770 DATA "NOT YOUR EVERYDAY", "NOT A FEEBLE", "NOT A FLIMSY", "NOT A HUMBLE"
02780 DATA "NOT A HUMDRUM", "NOT AN INCHOATE", "NOT AN INSIGNIFICANT"
02790 DATA "NOT A LITTLE", "NOT A MEAGER", "NOT A MEEK"
02800 DATA "NOT A MERE WISP OF A", "NOT A MINUTE", "NOT A MODEST"
02810 DATA "NOT AN OBSCURE", "NOT YOUR ORDINARY", "NOT A PALTRY"
02820 DATA "NOT A PETTY", "NOT A PIGMY OF A", "NOT A PUERILE", "NOT A PUNY"
02830 DATA "NOT A SCANTY", "NOT TO SHABBY OF A", "NOT A SHALLOW"
02840 DATA "NOT A SIMPLE", "NOT A SMALL", "NOT A TINY", "NOT A TRIFLING"
02850 DATA "NOT A TRIVIAL", "NOT AN UNDERSIZED", "NOT AN UNNOTICEABLE"
02860 END
READY.
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Strategy Games

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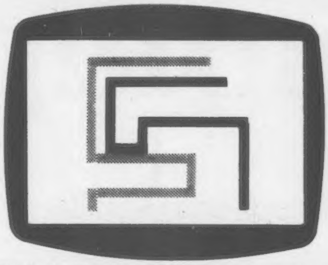
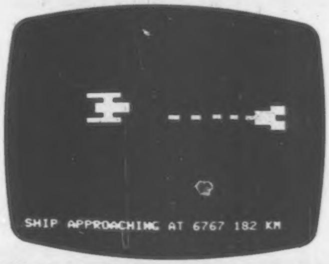


Blockade. Build a wall to trap your opponent, but don't hit anything.



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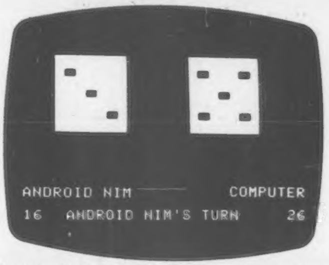
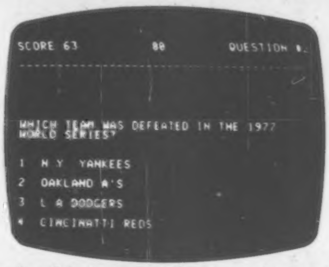


Skunk. A 2-player strategy game played with dice, skill and luck.



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SCORE 63          80         QUESTION
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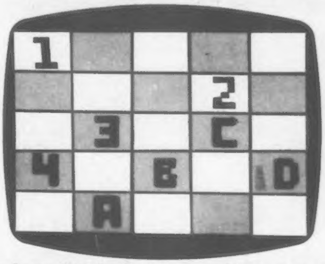
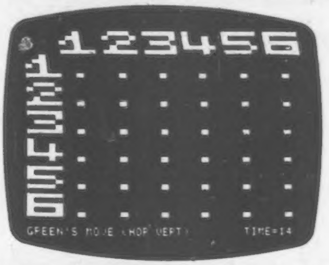
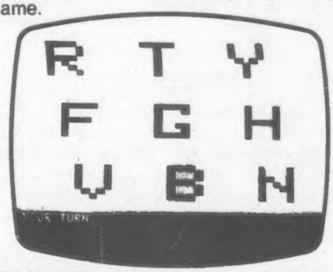


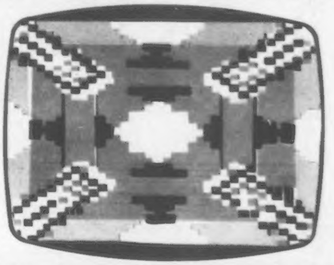
Dodgem. Be the first to move all your pieces across the board in this intriguing strategy game.



Nuclear Reaction. A game of skill, fast decisions and quick reversals of position.



Parrot. A Simon-type game with letters and tones. **Dueling digits** is a version with numbers.



Midpoints and Lines. Two colorful graphics demonstrations. **Tones** lets you make music and sound effects.

Strategy and Brain Games are also available on one 32K Apple disk (CS-4502) for $24.95. Add $2.00 shipping per order. Send to **Creative Computing Software**, P.O. Box 789-M, Morristown, NJ 07960. Or call 800-631-8112.

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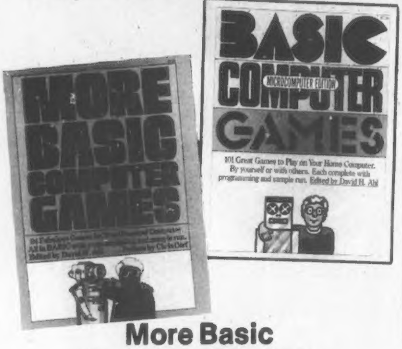
creative computing ...

Basic Computer Games

Edited by David Ahl, this book contains 101 imaginative and challenging games for one, two, or more players — Basketball, Craps, Gomoko, Blackjack, Even Wins, Super Star Trek, Bombs Away, Horserace. Simulate lunar landings. Play the stock market. Write poetry. Draw pictures.

All programs are complete with listing in Microsoft Basic, sample run and description. Basic conversion table included. 125,000 copies in print. 192 pages softbound. [6C] $7.50.


MORE BASIC COMPUTER GAMES
BASIC COMPUTER GAMES
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101 Great Games to Play on Your Home Computer. By yourself or with others. Each complete with programming and sample run. Edited by David H. Ahl

More Basic Computer Games

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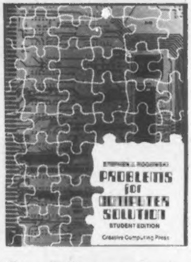
The Best of
creative computing
Volume 1 Edited by David H. Ahl

THE BEST OF
creative computing
VOL. 2 EDITED BY DAVID AHL

The Best of Creative Computing

The first two years of **Creative Computing** magazine have been edited into two big blockbuster books. **American Vocational Journal** said of Volume 1, "This book is the 'Whole Earth Catalog' of computers." [6A] Volume 2 continues in the same tradition. "Non-technical in approach, its pages are filled with information, articles, games and activities. Fun layout." —**American Libraries.** [6B] Each volume $8.95.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STUDENT EDITION
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Problems for Computer Solution

Here are 90 problems with a thorough discussion and references for each. Eleven types of problems are included, for example, arithmetic, algebra, geometry, number theory, probability and science. Even includes three classic unsolved problems and seven appendices. 104 pages softbound, $4.95 [9Z].

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Katie AND THE COMPUTER
by Fred D'Ignazio
Illustrations by Stan Gilliam

Katie and the Computer

Fred D'Ignazio and Stan Gilliam. This is a delightful story told in words and full color drawings of Katie's adventures when she "falls" into a computer. In Katie's journey through the land of Cybernia she meets the Software Colonel, the Bytes, the Table Manager and even a ferocious Program Bug. Her journey parallels the path of a simple command through he stages of processing in a computer, thus explaining the fundamentals of computer operation to 4-10 year olds. Supplemental explanatory information is contained in the front and back end papers. 42 pp. hardbound $6.95. (12A)

creative computing
First Philadelphia Computer Music Festival

Computer Music Record

A recording was made of the First Philadelphia Music Festival which is now available on a 12" LP record. It features eight different computer music synthesizers programmed to play the music of J.S. Bach, J. Pachelbel, Rimsky-Korsakov, Scott Joplin, Neil Diamond, Lennon & McCartney and seven others. The music ranges from baroque to rock, traditional to rag and even includes an historic 1963 computerized singing demonstration by Bell Labs. $6.00 [CR101].

The Best of BYTE

The Best of Byte

This is a blockbuster of a book containing the majority of material from the first 12 issues of Byte magazine. The 146 pages devoted to hardware are crammed full of how-to articles on everything from TV displays to joysticks to cassette interfaces and computer kits. But hardware without software might as well be a boat anchor, so there are 125 pages of software and applications ranging from on-line debuggers to games to a complete small business accounting system. A section on theory examines the how and why behind the circuits and programs, and "opinion" looks at where this explosive new hobby is heading. 386 pp softbound. $11.95 [6F]

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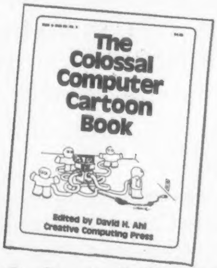
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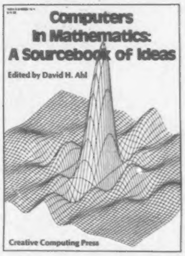

Computers in Mathematics: A Sourcebook of Ideas
Edited by David H. Ahl
Creative Computing Press

Computers in Mathematics: A Sourcebook of Ideas

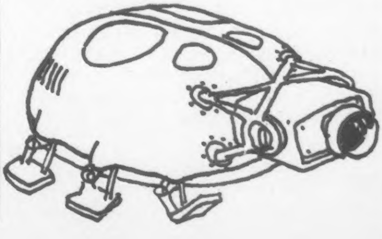
Here is a huge sourcebook of ideas for using computers in mathematics instruction. This large format book contains sections on computer literacy, problem solving techniques, art and graphing, simulations, computer assisted instruction, probability, functions, magic squares and programming styles.

One section presents over 250 problems, puzzles and programming ideas--more than is found in most "collection of problems" books.

Pragmatic, ready-to-use, classroom tested ideas are presented for everything from the most basic introduction to binary numbers to advanced techniques like multiple regression analysis and differential equations. Every item discussed has a complete explanation including flowcharts, programs and sample runs.

The book includes many activities that don't require a computer. And if you're considering expanding your computer facilities you'll find the section on how to select a computer complete with a microcomputer comparison chart invaluable.

Much of the material has appeared in **Creative Computing** but the back issues are no longer available. Hence this is your only source to this practical and valuable material. Edited by David H. Ahl, this mammoth 224-page softbound book costs only $15.95. (The individual issues, if they were available, would cost over $60.00). [12D]



The Impact of Computers on Society and Ethics: A Bibliography

Gary M. Abshire. **REFERENCE**

Where is the computer leading us? Is it a menace or a messiah? What are its benefits? What are the risks? What is needed to manage the computer for society's greatest good? Will we become masters or slaves of the evolving computer technology? This bibliography was created to help answer questions like these. It contains 1920 alphabetical entries of books, magazine articles, news items, scholarly papers and other works dealing with the impact of computers on society and ethics. Covers 1948 through 1979. 128 pp hardbound. $17.95. [12E].

BE A COMPUTER LITERATE
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Be A Computer Literate

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This informative, full color book is an ideal first introduction to the world of computers. Covers kinds of computers, how they work, their applications in society, flowcharts and writing a simple program. Full color drawings, diagrams and photos on every page coupled with large type make this book easy to read and understand. Used as a text in many schools. 66 pp softbound, $3.95 [6H].

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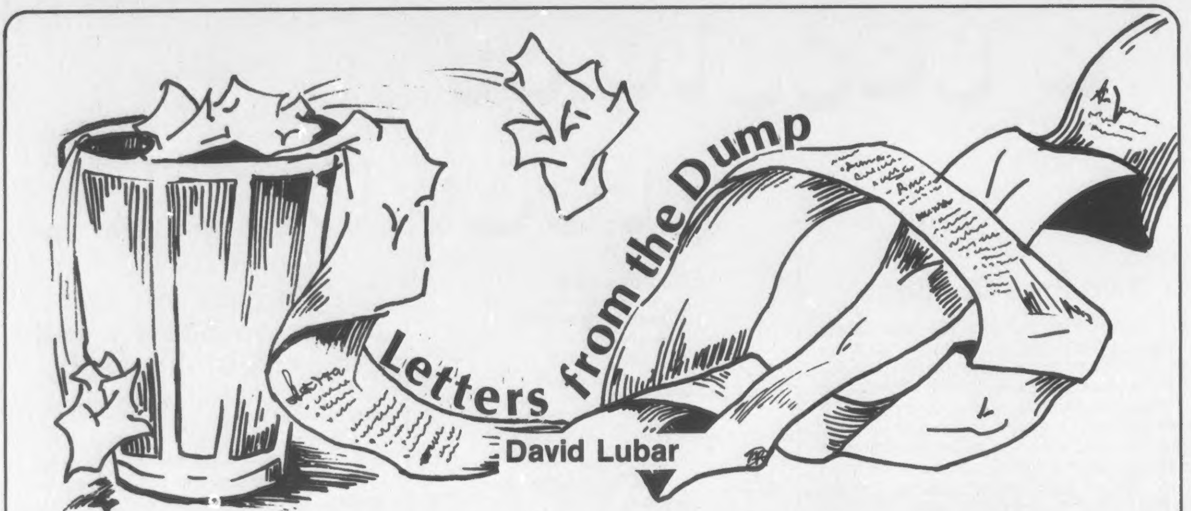


Letters from the Dump

David Lubar

We're trying to get away from machine language, but this is awfully useful — especially for finding out what commands are valid in Adventure games without a lot of silly guesswork.

Programs written in Basic are fairly easy to read. You can locate characters which will be printed just by scanning the listing in search of PRINT statements. In a long machine-language program, the process is more complicated since printed characters are represented in memory as hex data. The following article describes a short, simple routine for finding and displaying ASCII characters in machine-language programs. The routine is written for the Apple II, but could easily be modified to use with any other 6502 system.

There are a number of uses for this type of routine. If you want to modify the printout of a program, this routine will simplify the process. It can help find the keywords that are recognized by an interactive program.

If the program is stopped, the location of the last characters printed can easily be determined.

First, decide on a location to enter the routine. It can be placed either above or below the program you want to examine. In the following example, location 300 (hex) will be used. With the target program already in memory, enter the monitor's assembler by typing F666G. After entering the first line, remember to put one space before each of the remaining lines. If you aren't familiar with the monitor, don't worry; just type exactly what is listed below and ignore the strange things that happen to each line after you hit RETURN.

Following the ! prompt, type

```
      300:LDA 800
  (space) JSR FDF0
          LDA #A0
          JSR FCA8
          INC 301
          BNE 300
          INC 302
          JMP 300
```

That's all there is to it. The routine is ready to run. *CAUTION:* this routine contains self-modifying code. Normally, this is a poor programming technique and should be avoided. In this case, there is a reason for self-modification.

To use the routine, hit RESET, then enter the command 300G. A lot of meaningless characters will flow by, but all the words contained as data will also appear. If, at any point, you wish to determine where the data on the screen is stored, just hit RESET. This will stop the dump. Then, enter 300L. The first line of the routine will now be

LDA XXXX

where XXXX is the address of the next byte to be printed.

How does it work? First, the hex data from location $800 is put into the accumulator. (If the program starts higher up, you would replace 800 with the value of the first line of the program.) Then, the monitor's print routine (located at FDF0) is used to put the byte on the screen as an ASCII character. Since the routine is quite fast, a pause is needed before printing the next character. This is done by putting A0 into the accumulator and using the monitor's WAIT subroutine (located at FCA8). To increase or decrease the pause, just increase or decrease A0. Now for the self-modifying part.

The computer stores the command LDA 800 in three bytes at locations 300-302. 300 contains the hex code for LDA. 301 contains the lo byte of the operand and 302 contains the hi byte. The command INC 301 increases the value of location 301 by one. In other words, the program changes the value of one of its own commands. At this point, LDA 800 has become LDA 801. The value of the lo byte will go from 0-FF. After this, it will become 0 again. The BNE (branch on result not equal to 0) will keep sending control back to 300 until the command becomes LDA 8FF. At this point the branch condition will become false, so the program will move on to the next line (after incrementing FF to 00). Now, the hi byte is incremented, and the command at 300 becomes LDA 900. From then on, the cycle continues, increasing the lo byte from 00-FF, then increasing the hi byte by one. If the program is stopped, the location of the last characters printed can easily be determined.

A lot of meaningless characters will flow by, but all the words contained as data will also appear.

Remember, if you use this routine at a different location, you will have to change the values of the last four lines. Change the BNE and JMP to the value of the start of the routine, and change the INC commands to one byte (for the first INC) and two bytes (for the second INC) beyond the start of the routine.

Due credit dept. Thanks go to Richard Corcoran for suggesting the use of the WAIT subroutine, and for providing numerous bits of helpful input.

Happy dumping. □

For your Apple II....

MUSIC & GRAPHICS

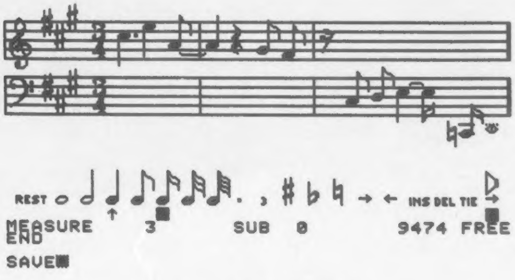
ALF Music Synthesizer

The ALF music synthesizer has three voices on each board which are easily programmed using the Entry program provided. The envelope shape of each voice (or even each note) may be controlled individually thus allowing the synthesis of practically any instrument such as a violin, trumpet, piano, harp or bells. Instrumentation and dynamics may be varied while a song is playing by changing the attack, sustain, release, decay, gap and volume of the notes.

Playback of music is accompanied by a spectacular color display showing a stylized "piano keyboard" for each part with the colors of the notes varying in proportion to their loudness and waveform.

Ease of Music Entry

Music is entered directly using the high-resolution graphics entry program. One paddle is used to select menu items such as note duration, accidentals, dotted notes, triplets, tied notes, etc. while the other paddle moves a note cursor up and down the staff over a 4-octave range. The transpose command extends the range to eight octaves. This form of music entry is considerably faster and more accurate than cryptic note code schemes (like QFS3) found with other synthesizers.



MUSIC ENTRY SCREEN

The board plugs into any Apple II or Apple II Plus. Two or three boards are required for stereo. Requires a 16K Apple system and external amplifier and speakers.

*ALF Apple Music II (AM-II) Synthesizer

The AM-II is a new, low cost digital music synthesizer for the Apple II computer. It features 9 voices on a single music card.

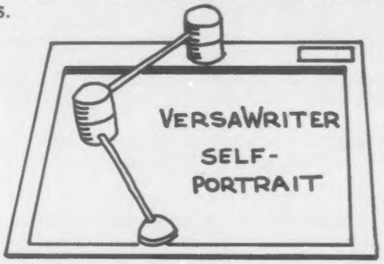
The software ENTRY and PLAY systems are the same as on the ALF Apple Music Synthesizer (AMS). The two principle differences between the new AM-II and the original Apple Music Synthesizer are in pitch range, volume range, and parts per board.

The new AM-II has a range of six octaves. The dynamic range is 28 db. (The original AMS has a range of 8 octaves a dynamic range of 78 db and 3 parts per board.)

VersaWriter

VersaWriter is a drawing tablet for the creation of full-color, high resolution graphic images on the Apple. Images may be drawn freehand or traced from existing images (cartoons, photos, drawings, etc.) using the simple pivoted two-arm pantograph with magnifying crosshairs.

After an image is drawn, it may be rotated, shrunk, or enlarged. It may be moved across the screen and alternated with other images thus providing high-resolution animation. The image may be colored with varied colors.



Animate other Programs

Graphical images made with VersaWriter and stored on tape or disk may be called from other programs or even imbedded in them. With VersaWriter, you don't have to worry about assembly code, counting pixels or other cumbersome hi-res graphics entry and retrieval techniques.

VersaWriter graphics can be used in all types of programs—games, statistics, engineering, artistic, and educational. Your only limit is your own imagination.

Two Disks of Software

Disk 1 contains the basic plotting, scaling, movement, rotation, color, transfer and recall software. This disk also includes routines which create "shape tables" from your figures to be used in other programs. Disk 2 contains applications software. One program adds five sizes of upper and lower case text to drawings, another adds standard electronic and digital symbols, while a third calculates distances and areas.

VersaWriter requires a 32 or 48K disk system, Applesoft in ROM or an Apple II Plus.

VersaWriter	$252.00
ALF Music Synthesizer	$268.00
AM-II Synthesizer	$198.00

Prices postpaid in USA. NJ residents add 5% sales tax.

To order VersaWriter or the ALF Synthesizer, send your name and address along with a check or chargecard number and expiration date. Visa, MasterCard and American Express are welcome. Units are in stock and orders will be shipped as soon as your check clears or your credit is verified.

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Dealer inquiries invited.

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A Visit to PERSONAL SOFTWARE

Photos by David Ahl.

The people at Personal Software believe that there will be no great increase in natural resources or people resources in the coming decade. Thus people and companies will have to make more efficient use of existing resources. To Personal Software this means a strategy to emphasize management efficiency through packages such as VisiCalc, Desktop Plan and Data Management System.

1. Most Personal Software packages are acquired from outside and relatively little development is done internally. This photo would tend to verify that. (Actually, it was taken after 5pm).
2. Erik and Ted Nelson look over some new software.
3. Manufacturing of Apple disks is done one at a time with a copy program.
4. Accounting and order processing in Personal's new, spacious quarters in Sunnyvale.
5. A corner of the stockroom. (At Creative Computing, our 2-foot aisles don't permit such photos. It must be nice to have space!)

3

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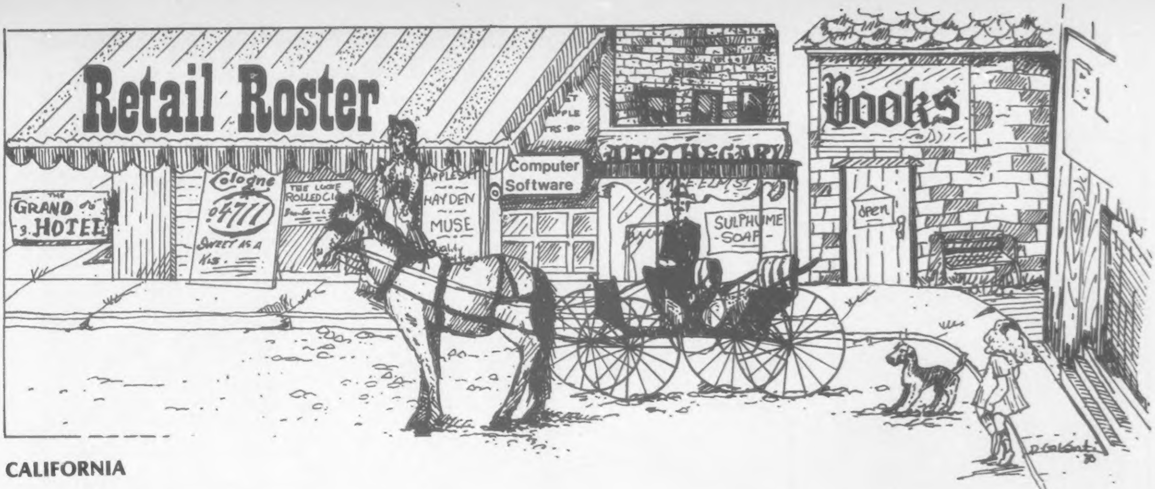

CALIFORNIA

The Computer Store—820 Broadway, Santa Monica 90401; (213) 451-0713. 10 am-8 pm Tue-Fri, 10-6 Sat. The Original One! Apple/Vector Graphic.

D.E.S. Data Equipment Supply—8315 Firestone, Downey 90241. (213) 923-9361. 7 days. Commodore PET specialists. Hardware Software, Books, Mags, Supplies, In House Maintenance.

PC Computers—10166 San Pablo Ave, El Cerrito 94530; (415) 527-6657. 9-5:30 Mon-Sat. Commodore Pet, Compucolor and Atari.

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Computerworks—1439 Post Rd. East, Westport 06880; (203) 255-9096. 12-6 Mon-Sat., 12-9 Thurs.

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Atlanta Computer Mart—5091 Buford Hwy, Atlanta 30340; (404) 455-0647. 10-6 Mon-Sat.

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ComputerLand/Downers Grove—136 Ogden Ave, Downers Plaza 60515; (312) 964-7762. 10-6 Mon-Sat, 10-8 Tue, Thu.

The Computer Room—106 E. Oak St, Chicago 60611; (312) 337-6744. 11-7 Mon-Fri, 11-6 Sat.

Data Domain of Schaumburg—1612 E. Algonquin Rd, Schaumburg 60195; (312) 397-8700. 12-9 Tue-Fri, 11-5 Sat. Largest book & magazine selection.

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The Computer Corner Inc—200 Hamilton Ave, White Plains 10601; (914)-WHY DATA. 10-6 Mon-Sat, 10-9 Thu.

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The Basic Computer Shop—2671 W. Market St, Akron 44313; (216) 867-0808. 10-6 Mon-Sat.

Micro Mini Computer World, Inc.—74 Robinwood Ave., Columbus 43213; (614) 235-6058, 5813. 11-7 Tue-Sat. Authorized Commodore dealer-Sales/Software/Service/Support.

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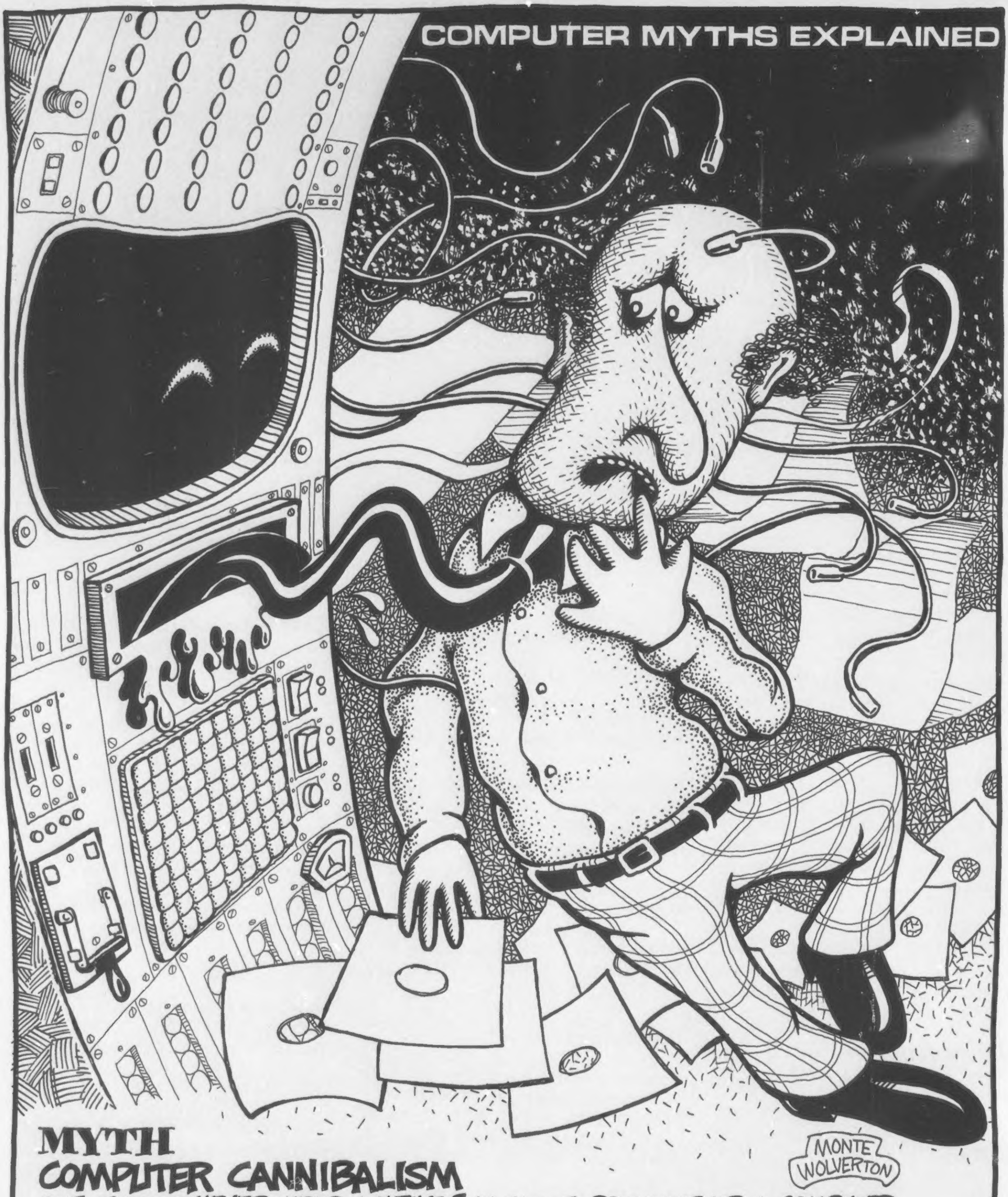
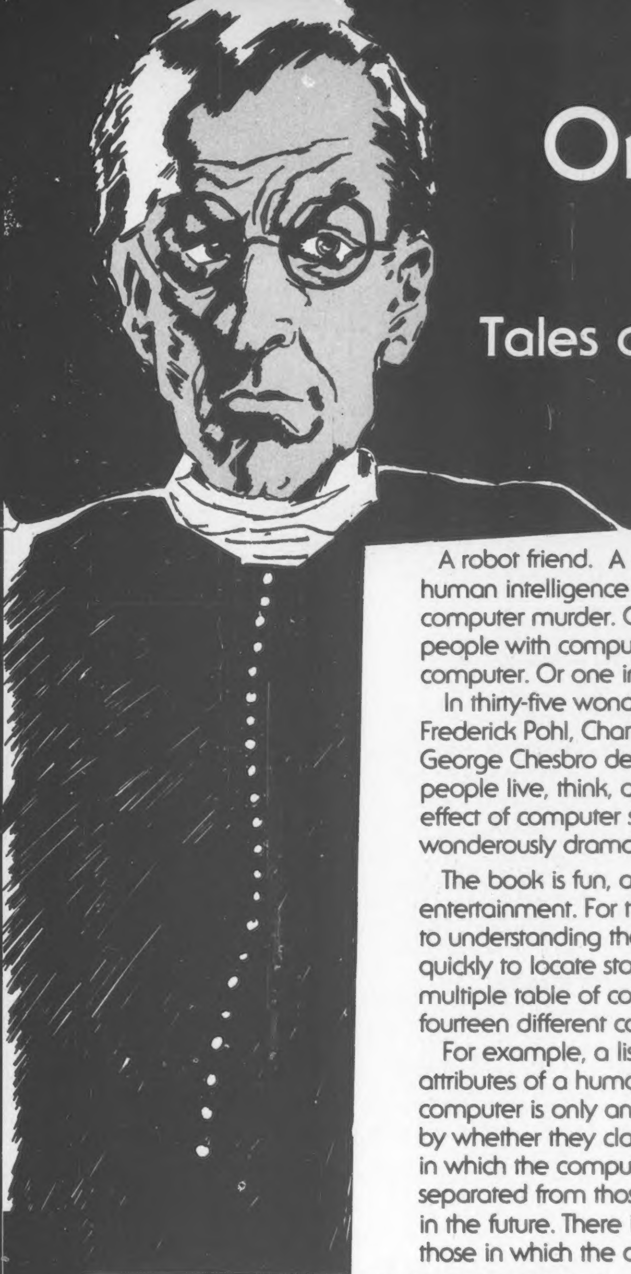


MYTH
COMPUTER CANNIBALISM

ONE SHOULD **NEVER** WEAR A **NECKTIE** IN CLOSE PROXIMITY TO A **COMPUTER**, SINCE THEY ARE FREQUENTLY WONT TO **GRAB** SAID NECKTIES, THROUGH THEIR EVER-PRESENT, MULTI-PURPOSE **SLOTS!** OFTEN, ENTIRE **PERSONS** HAVE **VANISHED** THROUGH THESE SLOTS, NEVER TO BE RETRIEVED, HAVING BEEN **FILED** IN SOME REMOTE CORNER OF THE **RAM**, AND SUBSEQUENTLY **REPRESSED**, A FATE WHICH MAY SOUND **ATTRACTIVE** TO SOME... BUT DON'T GET SUCKED **INTO** THIS SITUATION! IF YOU **MUST** WEAR A NECKTIE AROUND A COMPUTER, MAKE SURE IT'S **FAKE!** (THE NECKTIE OR THE COMPUTER)



Only Fiction . . . or is it?

Tales of the Marvelous Machine:

35 Stories of Computing

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In thirty-five wonderful stories about computers, authors such as Frederick Pohl, Charles Mosmann, M.V. Mathews, Carol Cail, and George Chesbro depict a life in which computers affect the way people live, think, and relate to each other. Interested in what the effect of computer saturation might be? Only fiction can so wonderously dramatize future life.

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Can criminals be caught by computer? Does computer crime pay? Do computers fall in love? Are we all part of a larger organic computer? Here are 35 tantalizing tales that will open your eyes to a new perspective of computers.

Skillfully drawn illustrations augment the stories, giving glimpses of scenes as envisioned by 20 talented artists. This artwork adds another dimension to the text.

Tales of the Marvelous Machines: 35 Stories of Computing, edited by Robert Taylor and Burchenal Green, is a beautiful big 8½" × 11" softbound anthology of 272 pages. 12B

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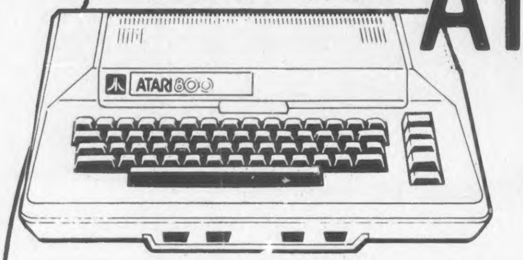

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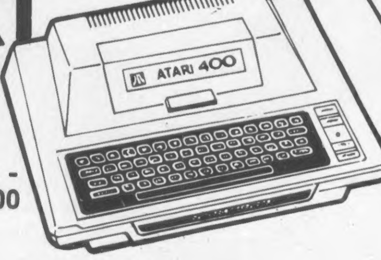

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Effective Writing

Edmond H. Weiss, Ph.D.

How Not to Write a Command

Edmond H. Weiss, a communications consultant, teaches effective writing seminars for business, industry and government. To contact him, call 609-795-5580.

The worst time to write badly is when you are giving a command. Or instruction, or direction, or procedure. Telling readers what to do and how to do it leaves no margin for clumsy, unclear writing. The consequences are irritating at best, devastating at worst.

Software manuals (which, page for page, are the worst written objects in print) tend to be filled with cryptic, cluttered, awkward commands and directions. Notice that the people who buy the software can rarely use the manuals without "consultation" from the vendor. (The "consultant" explains the unreadable manual.) And, increasingly, major firms feel compelled to *write their own documentation,* replacing the unusable junk provided by the vendor.

Of course, unclear instructions are not the only problem with software documentation. But it may be the most serious — even though, ironically, it should be the easiest to solve.

Fortunately, most commands and instructions fit into one of just four categories, defined by the matrix below.

STATUS / PERSON	UNCONDITIONAL	CONDITIONAL
SECOND PERSON	1. "Enter the password."	3. "To get a list of file names, enter your security code."
THIRD PERSON	2. "The user must then enter the password."	4. "If the analyst wants another view of the data base, he must get approval from the DBM."

Basic Blunder #1

Even though all four forms of commands are legitimate, you should know, first, that Second Person commands (1 & 3) are much easier to read than Third Person commands (2 & 4). Just consider these examples:

- Users who wish to find what file names have been assigned should enter DFIL. (Clumsy)
- If the user wants to know what file names have been assigned, he or she should enter DFIL. (Ghastly)

How much clearer to write:

- To find what file names have been assigned, enter DFIL.

Basic Blunder #2

In almost every case, conditional commands (3 & 4) should *start with the condition.* The second basic blunder is putting the condition at the end, as in:

- Enter DFIL to find what file names have been assigned.
- The user should enter DFIL when he wants to know which file names have been assigned. (Both blunders)

In conditional commands, as in most complex sentences, the sentence reads better with the subordinate or dependent clause first and the main, independent clause last. In a well-written sentence the main information comes *at the end.* (Consider the sentence you just read.) That's especially true for commands.

Other Blunders

Do not write commands in the *passive* unless you have some compelling reason to do so. Consider this example:

> *Before (passive):*
> Clearly defined instructions for the preparation and handling of user supplied input must be provided by the Systems Analyst during the Implementation Phase.
> *After (active)*
> During the Implementation Phase, the Systems Analyst must give clear instructions about the preparation and handling of user supplied input.

Writing with passives also leads to *dangling* constructions. First, the *dangling participle:*

> *Before*
> When initializing a system with a coldstart, a tape containing the operating software is loaded.
> *After*
> When initializing the system with a coldstart, load the tape containing the operating software.

Next, the *dangling infinitive:*

> *Before*
> To print the column arithmetic, DCOL should be entered.
> *After*
> To print the column arithmetic, enter DCOL.

Be suspicious of any command or instruction that has the words *requirement, responsibility* or their related forms. You can usually replace these clumsier forms with the verbs *must, should,* or *has to.*

> *Before*
> The user is required to approve continuation of a project by signing-off on Form 301.
> *After*
> To approve the continuation of a project the user must sign-off on Form 301.

> *Before*
> The responsibility for organizing

Edmond H. Weiss, Ph.D., 1612 Crown Point Lane,
Cherry Hill, NJ 08003.

Writing, cont'd...

and scheduling the User's Review rests with the program manager responsible for the project to be reviewed.

After

The program manager in charge of the project to be reviewed should organize and schedule the User's Review.

Final Warning

All the advice that applies to good writing in general applies to writing commands in particular. Do not write in strings of nouns. (What, for example, is a "problem responsibility change code list update"?) Do not show off. (Replace *utilize* with *use*. Write *give* instead of *provide.*) Write with verbs. (Instead of *file linkage can be achieved* write *the files can be linked.*)

Realize that the computer industry is entering a documentation crisis. And if the computer people do not start doing a better job with their instructions and manuals, then, not too long from now, someone else will be doing the job for them. □

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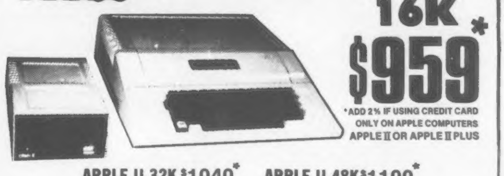

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Software Legal Forum

The comments and opinions of the author are given for educational purposes only and are not meant to be legal advice. Specific legal questions should be referred to your personal attorney.

Harold L. Novick

This month's column will be a potpourri of items while awaiting some judicial pronouncements. These pronouncements include the Supreme Court opinions in the two computer program patent cases (as well as two more similar cases that have been subsequently filed), the higher court results in some tax cases, and the outcome of an appeal in the CompuChess case (see January 1980 *Forum).*

The first two items concern some comments made by Martha Gore made in the last *Forum.* During the early correspondence with her, it appeared that her article would come down hard on the legal types, with whom this author has some affinity. However, she did not and in fact strongly recommended that legal questions be answered only by a competent lawyer. An admirable thought! Lawyers need to earn a living too.

Actually, if one is undertaking a business venture or a large capital purchase, two indispensible allies are a good accountant and a good lawyer. A useful hint for any business endeavor is that one can not afford to have a bad accountant or a bad lawyer. The worst accountant and the worst lawyer one can have is himself or herself. As for the expense involved, good accountants and good lawyers are less expensive in the beginning when they keep their clients out of trouble, than in the end when they must extricate their clients from self-made, preventable difficulties.

The second item concerns the statement in Martha Gore's article about the importance of registering one's claim for a copyright. With all due respect, this author has another view.

A valid copyright is created as soon as the "writing" has been fixed in a tangible medium of expression. As soon as you write a computer program on a piece of paper or store it in a computer memory, it is copyrighted. The new law has drastically changed the prior requirement for "publication" in order to obtain a copyright. However, the new law does not require that the copyright *claim* be filed: Ever. There are certain advantages to filing the claim, such as overcoming improper publication without copyright notice or being able to collect damages from an infringer before notice of infringement is sent. The disadvantage to filing a copyright claim is that a copy of the computer program must also be submitted. This making public of the computer program could destroy any trade secrets also being claimed. This is a high price to pay.

It is this author's opinion that there should be a presumption *not* to file the claim for copyright. The claim and copy of the program should only be filed if there are good reasons for filing them.

The third and final item this month concerns an exchange of letters between this author and Mr. Piescik of Cuddly Software, 157 Charter Road, Wethersfield, CT 06109. The first series of letters are printed below. The final, rather lengthy, rebuttal of Mr. Piescik could not be fitted in this month's *Forum* and will be printed in next month's column. The "Data Cash" decision that is mentioned is the case of *Data Cash Systems, Inc. v. JS & A Group, Inc.*, 203 USPQ 735 (N.D. Ill. 1979), discussed in the January, 1980 *Forum.*

March 31, 1980

Dear Mr. Novick:

Thank you once again for the copy of the Data Cash decision!

If the interpretation of the nature of object code in ROM is legally correct, the decision is reasonable, albeit unfavorable. I don't believe the mistaken idea regarding the readability of such code is significant, other than as a reflection of the inadequacy of the present laws in protecting software, since it's nature is not fully understood by the powers that be.

While I have several drafts of my rebuttal on my desk, your March column leads me to believe that we are thinking along the same lines. My main points are protection of software through the various stages of development, with consideration of its polymorphic nature (recognition of identity between source, object, and intermediate code), and the trade-off between the producer's ability to recover initial development costs over a period of time, or faster recovery (of the cost) in fewer sales. Perferably, the identity of various program levels would be recognized, rather than covering each level of the same software with multiple copyrights and/or patents. Perhaps, we need a new form of protection, "Compu-right."

I won't develop this further, but at least you know your ideas are shared by a software producer, and mine, by a member of the legal profession!

Sincerely,
P.V. Piescik

April 3, 1980

Dear Mr. Piescik:

Thank you for your letter of March 31, 1980. I am eagerly awaiting the receipt of your rebuttal and urge you to put it in final form as soon as you can. You also mentioned in your letter that we should have a new form of protection for computer programs. For your information, this project is receiving active consideration on a number of different fronts. For example, the American Patent Law Association has a sub-committee on computer software development and protection. They are presently studying a proposed form of protection for computer programs which takes some thoughts from the patent system and some thoughts from the copyright system. An international organization, the World Intellectual Property Organization (WIPO), is also

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Harold L. Novick, Patent Attorney, Larson, Taylor & Hinds, Arlington, VA 22202.

proposing a similar concept. I also believe, but I am not sure, that someone in Congress is studying some alternative proposals.

My own thoughts in this area is that a "mini-patent" should be developed for computer programs. This type of protection would last for much less than a normal 17 year patent grant, but would protect the concept behind the program in a way similar to the protection afforded by the patent system. To make the system inexpensive, I would propose that it be a mere registration system instead of the present patent system which entails a thorough examination. An analogy would be the copyright system where the copyright is provided as soon as the work is "fixed" in an appropriate medium of expression and then simply registered.

Unfortunately, I do not believe that anything is forthcoming in this area within the next 10 to 20 years unless a huge lobbying campaign is organized in the interim.

Again I thank you for your letter and your thoughts and hope you will continue to be an active critic of my column in *Creative Computing* magazine.

Sincerely,
H.L. Novick

April 9, 1980

Dr. Mr. Novick:

Your letter of 4/3/80 leads me to two conclusions: 1) you will not be satisfied with a synopsis (my letter of 3/31/80) of my thoughts on software protection and the implications of the Data Cash case, and 2) we are not as close in our thinking as I believed after reading your March column.

As you wish, the rebuttal is back into the grist mill; I have an immediate, and briefer reaction to your "mini-patent" concept.

I have two objections to protection of software rights by patent. First, if the present requirement of "usefulness" is retained, it may disqualify a major class of software — systems and support software. Operating systems, language processors, and "canned" utilities (sort/merge, device-to-device copiers, etc.) are the tools of computer science, and possibly would be excluded from such protection. As a systems specialist, I might fare no better under software patents than under present copyrights.

Second, I do not believe that the concept behind the program is the entity to be protected! The analogy coming to mind is that of a patented chemical process, which yields either a unique product, or provides an advantageous method for production of an existing compound. The "concept" behind a computer program is again a "process," which is somewhat ethereal.

The process has a tenuous existence! A process exists only during the execution of the instructions describing it for the computer. A Basic program to play "Star Trek," for instance, involves several processes, apparently concurrent to the human observer. However, "Star Trek" (hereafter, "ST" for short) does not exist while the Basic interpreter finds the next program statement and determines what it is; ST only exists during the execution of the machine-language routine corresponding to the statement.

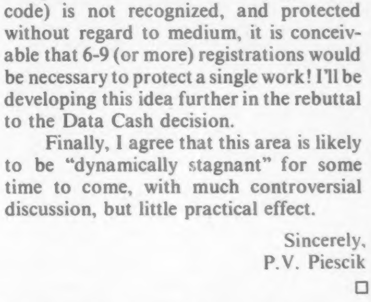
In light of the distinction between program and process, a better analogy (if not original) is that of an accounting textbook and the accounting method it describes. The textbook description of the method is protected by copyright; the method, however, does not become exclusively the author's. A program describes a process for the machine to perform, and is a description, not a process. Were the software mini-patent to protect the process, rather than the description, it might well be construed as excluding subsequent releases of a Basic interpreter, once the first interpreter program were covered.

I also think that the fixation of a program in some medium for registration may be too restrictive and/or cumbersome to realize full protection of software while retaining its utility. It is reasonable to expect a program to exist in at least two forms (source code and object code) and three media (documentation, storage medium, and memory) concurrently to be most useful to the end user. If the identity of the source program and object code (and, in the case of high-level language compilers, intermediate assembly source code) is not recognized, and protected without regard to medium, it is conceivable that 6-9 (or more) registrations would be necessary to protect a single work! I'll be developing this idea further in the rebuttal to the Data Cash decision.

Finally, I agree that this area is likely to be "dynamically stagnant" for some time to come, with much controversial discussion, but little practical effect.

Sincerely,
P.V. Piescik

☐



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A question came up recently about the software I review. I explained that I only review the stuff that seems to be well done. That is, the documentation does not leave you guessing, the programs have decent human factors, and that there appears to be reasonable support should there be any problems. In the case of software, I haven't reviewed anything unless I have used it for some time. Some of the packages that were sent to me were returned or discarded. As for hardware and such physical devices, my attitude is much the same. If I don't or can't use the device, I don't write a review of it. (Except for the Apple III which I did from Apple's release documentation.) Occasionally, when I personally know that several people are using a product with good results, I'll interview them and use the information in limited reviews.

So, if you are wondering about a particular piece of software or a hardware peripheral widget, check the other articles in *Creative Computing*. There are a number of reviews presented each month. And, if you have been following the letters, you will know that the reviews have provoked lots of replies because of their honesty. There is a bimonthly newspaper type publication, too, called Infoworld. A number of software packages are reviewed there every two weeks or so. The coverage is for more than just Apples, but a lot of Apple software is reviewed. Like any other review, *you* must be the final judge. Each of us has our personal biases and prejudices and reviews will reflect this. It appears to be contra-human to be totally objective. Which brings me to the review I did on Apple III in the August '80 Apple Cart. My report indicated the keyboard was detached. Not so! Well, so much for third-hand review information.

From Down Under

Alan Thomas from Tasmania, Australia sent this program back in March '80. My intention was to include it several months ago. I lost it, Alan has kindly replaced it, and now I can include it. To better understand Alan's routine, recall the significance of the ASCII values used in the CHR$ statements:

- CHR$(7) Control G(bell)
- CHR$(8) Control H(backspace) <--
- CHR$(13) Control M(return)
- CHR$(21) Control U(forward space)-->
- CHR$(32) Space bar
- CHR$(44) Comma
- CHR$(58) Colon

A complete list of the decimal values for all the ASCII characters can be found on pages 138-139 in the Applesoft Reference Manual. Here's the description sent by Alan for his program.

Alan relates . . . I am writing to describe a problem I have come across and to give a solution — refer to the program in Listing 1.

The problem is the statement INPUT A$ or, should I say, the problem is actually its inflexibility. On many occasions I have wanted to do things with INPUT characters, but the INPUT statement coldly allows you to do almost anything until you press RETURN and only then do you realize you have an EXTRA IGNORED error or you have accidentally put in more characters than you wished. The remedy is the subroutine from lines 10000-10025. Lines 10-30 are a small demonstration program, where GOSUB 10000 is equiva-

```
]LIST

10  TEXT : HOME
20  PRINT "ENTER STRING -"
30  PRINT
40  GOSUB 10000
50  PRINT : PRINT A$: END
10000 A$ = "":A1$ = "":A2$ = ""
10001 A3$ =  CHR$ (7):A4$ =  CHR$ (8):A5$ =  CHR$ (13):
     A6$ =  CHR$ (21):A7$ =  CHR$ (32):A8$ =  CHR$ (44)
     :A9$ =  CHR$ (58)
10002  GET A$
10003  IF A$ = A6$ AND A1$ = "" AND A2$ <  > "" THEN A$
      =  LEFT$ (A2$,1): GOTO 10022
10004  IF (A$ = A6$ OR A$ = A7$) AND A1$ = "" THEN A$ =
     A7$: GOTO 10012
10005  IF A$ = A6$ AND  LEN (A2$) >  LEN (A1$) THEN A$ =
      MID$ (A2$, LEN (A1$) + 1,1):A1$ = A1$ + A$: GOTO
     10025
10006  IF A$ = A6$ THEN A$ = A7$: GOTO 10012
10007  IF A$ = A4$ AND A1$ = "" GOTO 10002
10008  IF A$ = A4$ AND  LEN (A1$) = 1 THEN A1$ = "": GOTO
     10025
10009  IF A$ = A4$ THEN A1$ =  LEFT$ (A1$, LEN (A1$) -
     1): GOTO 10025
10010  IF A$ = A8$ OR A$ = A9$ THEN  PRINT A3$;: GOTO 1
     0002
10011  IF A$ = A5$ THEN A$ = A1$ + A$: PRINT : RETURN
10012  IF  LEN (A1$) = 39 THEN  PRINT A3$;: GOTO 10002
10022 A1$ = A1$ + A$
10023  IF  LEN (A2$) >  LEN (A1$) THEN A2$ = A1$ +  RIGHT$
     (A2$, LEN (A2$) -  LEN (A1$)): GOTO 10025
10024 A2$ = A1$
10025  PRINT A$;: GOTO 10002

]  REM  BY: ALAN THOMAS : 7 MAR '80
```

Listing 1.

lent to INPUT A$, with a few additions. The subroutine uses GET A$, so that every character is checked as it is typed in.

Features

1. Using the backspace arrow key, you cannot move the cursor or print characters back beyond the first character position.

2. If you have already printed some characters, you may go back and forth as desired, using the arrow keys.

3. Line 10010 checks to see that you do not input the comma or colon; they are not legal input characters. A beep is announced (control G) to let you know. This is to save later frustration if you have, for example, written A$ into a disk record and subsequently read it back using the INPUT statement. You will then most likely see on your screen an unwanted ?EXTRA IGNORED. However, if you are not going to use an INPUT statement, but only the PRINT A$ statement, then the comma and colon are allowed as input characters and the error will not occur. For such functioning, just delete line 10010.

4. The INPUT statement does not allow you to print leading spaces (such as for headings in a central position), while this subroutine will allow you to fill with spaces to a desired position, using either the SPACE BAR or the right arrow key.

5. Lines 10012-10021 may be used to include your own input conditions. For instance, line 10012 has already been included to make sure that you do not input more than 39 characters.

6. You may type as fast as you like, or you may use the repeat key.

7. When you have finished typing your string, press the RETURN key and the string A$ will appear on your screen . . .

Alan's program is a good example of solving a programming limitation by use of other program functions. Since all the ASCII characters can be tested using CHR$, many other program options are possible.

Saving Strings on Tape

In the February '80 column, I mentioned (briefly) something about saving strings on tape. At the time, I hadn't a need to do this nor had I found a suitable program. The SAVE and RECALL commands are available but these are intended for numerical arrays. I recently purchased a *Best of Contact '78*. This is a collection of many of the programming ideas included in the 6 issues of *Contact* As you may recall, *Contact* was published briefly by Apple as a house newsletter. I found a copy of '*Best of*' in several of the local computer stores. For those of you living where computer stores are few and far between, try the Apple hot line or write to them for a mail source. There's some good info in the '*Best of*' so try to get a copy. Now back to saving string on tape.

```
1 :
2  REM : PROGRAM TO SAVE STRINGS TO
3  REM : CASSETTE TAPE.
4  REM : BY: R. WIGGINTON (6/78)
5 :
10  DIM A$(10)
20  PRINT "TYPE IN NINE STRINGS, SEPARATED BY": PRINT "C
     ARRIAGE RETURNS. "
30  FOR K = 1 TO 9: INPUT A$(K): NEXT K
38 :
40  REM  NOW SAVE A$ TO TAPE
42 :
50  GOSUB 1000
55  PRINT "STRINGS ARE NOW ON TAPE.  TO RECALL,     TYPE
     'GOTO 100', REWIND AND START TAPE, AND PRESS 'RETUR
     N'."
58  PRINT "LET TAPE RUN UNTIL CURSOR RETURNS."
60  END
98 :
100  REM  THIS PART RECALLS THE STRINGS FROM TAPE.
102 :
110  DIM B$(10)
120  GOSUB 2000
130  FOR K = 1 TO 9: PRINT B$(K): NEXT K
140  END
148 :
1000  REM  STORE A$ TO TAPE.
1002 :
1004  PRINT "INSERT CLEAN TAPE, START RECORDING."
1006  PRINT "PRESS ANY KEY WHEN READY": GET Z$
1010 X =  FRE (0): STORE A$
1012 :
1020  REM  STORE A$ REALLY STORES POINTERS
1022  REM  IN ORDER FOR THIS PROGRAM TO WORK, HIMEM MUST
      BE AT THE SAME
1024  REM  VALUE WHEN THE STRINGS ARE RECALLED AS WHEN T
     HEY ARE STORED.
1026 :
1030 X =  PEEK (115) +  PEEK (116) * 256 -  PEEK (111) -
      PEEK (112) * 256
1040  GOSUB 2100
1050  POKE 30,X -  INT (X / 256) * 256: POKE 31,X / 256:
      CALL  - 307
1052 :
1054  REM  PUT (X) INTO LOCS 30&31, AND WROTE IT TO TAPE
      .
1056 :
1060  REM  (X) IS  THE LENGTH OF THE STRING AREA.
1062 :
1070  POKE 60, PEEK (111): POKE 61, PEEK (112): POKE 62,
      PEEK (115): POKE 63, PEEK (116): CALL  - 307
1072 :
1080  REM  HAVE NOW WRITTEN EVERYTHING.
1082 :
1090  PRINT "O.K. ": RETURN
```

Listing 2A.

```
 LIST 2000-

2000  RECALL B$
2002 :
2004  REM  GOT POINTERS BACK.
2006 :
2010  GOSUB 2100: CALL  - 259
2012 :
2014  REM  GOT LENGTH OF STRING BACK
2016 :
2020 X =  PEEK (30) +  PEEK (31) * 256
2022 :
2024  REM  X IS LENGTH OF AREA TO READ IN
2026 :
2030 X =  PEEK (115) +  PEEK (116) * 256 - X
2040  POKE 60,X -  INT (X / 256) * 256: POKE 61,X / 256
2050  POKE 62, PEEK (115): POKE 63, PEEK (116): CALL  -
     259
2060  RETURN
2100  POKE 60,30: POKE 61,0: POKE 62,31: POKE 63,0: RETURN

2102 :
2104  REM  SET CASSETTE ROUTINE POINTERS

]
```

Listing 2B.

String Saving Program

Listing 2 is the program I found in '*Best of*' for saving and recalling strings from tape. The program is in Applesoft and was written by R. Wigginton from Apple Co. The program is divided into three major sections.

- String input, lines 20 & 30

Cart, cont'd. . .

- Saving the strings, lines 50 and 1000 to 1090
- Recalling the strings, lines 110 to 140 and 2000 to 2060

Most of the program is self-explanatory. At least as far as using it, that is. Some of the peeks and pokes are not so obvious, and a little discussion will be useful. First, remember that a PEEK is used to examine the contents of a memory location. A POKE is used to store a value into a memory location. The values used are the decimal equivalents of hexadecimal numbers.

The string input section in lines 30 and 40 lets you put in 9 strings. By changing the dimension, you can allow as many strings as you would need. So far so good. In line 50 the program jumps to line 1000. This line is the start of the program for saving the strings to tape. Lines 1003 and 1005 allow you to set-up the tape for recording. Once the tape is ready, start the recorder then press any key. Then in line 1010, the variable X is made equal to the amount of free memory left and stored on the tape as a pointer. You will notice that X is the only numeric variable used in this program. It is used, however, in such a way that there is never any conflict. This is a useful technique to remember if you want to save memory. Next in line 1030, X is made equal to the length of memory used to store the strings. Applesoft stores strings starting at high memory down. Decimal memory locations 115 and 116 (hex 73 & 74) contain the address of high memory. The pointer for the address of the start of string storage is in locations 111 and 112 (hex 6F & 70) and this value is subtracted from high memory.

These pointer locations are found on pages 140 and 141 in the Apple II Reference Manual. If you want to find the address, in decimal, stored at any location, use the pointers in direct commands like this.

```
PRINT PEEK(LO)+256*PEEK(HI)
```

Where LO is the low number in the pointer and HI is the high number. Also realize that the opposite is true of the bytes of the actual address. The low number is the high byte and the high number is the low byte. Confusing isn't it! Let's continue with the save routines.

Line 1040 then jumps to a subroutine to set the cassette routine pointers. This is the same routine used when you type SAVE except it will be executed directly by this program. This step tells the routine where to find the data to be saved. On the RETURN, X, the length of the string area to be saved, is stored in two memory locations and then saved on tape. This is done with the command CALL -307. Next, the start and stop addresses of the string area are given to the tape save program and the entire string area is saved with another call to -307. Note that -307 is the machine language address of the tape save program in the monitor. The hexadecimal address is $FECD.

Getting it All Back

Once you have the strings saved to tape, the next task is to retrieve them. In this program, GOTO 100 sets-up the routine to read the data back into memory. At line 110 the number of strings to be read is dimensioned. Then, the program jumps to line 2000 where the actual tape RECALL will occur. Note that it is not necessary to use the same string variable. Only the data was saved and as long as the pointers and lengths remain the same, any variable can be used. Line 2010 recovers the pointers to the area in memory where the data will be returned. A-tape read call to memory location -259 does this. Location -259 in the monitor is the tape read program. The hexadecimal address is $FEFD. The next two lines appear to be in conflict. To do what was done here you need to know how the interpreter works. In line 2020 the variable X gets one value. Then, in line 2030, X gets another. The significance is that the value of X is not changed until all the steps following the equal sign are completed. Thus, there is no conflict and X winds up with the value it needs to read back the strings on the tape. After all the pokes are made in lines 2040 and 2050, the final tape-read is made with another call to -259. Following the return to line 130, the strings you stored are printed on the screen and the program ends at line 140.

The program works. After I typed it in and got rid of all my typos and mistakes, I succeeded in storing and recalling a list of strings. The problems will occur if you make any changes at all without rerunning the program segments that establish the pointers to memory and the string storage area length. These are critical. If you don't have a disk storage system, there are lots of possibilities for using this program. You could also connect a control circuit and drive the cassettes from the game paddle ports. Hmmm . . . Interesting idea for a future column.

```
]LIST

1000  REM ***************************
1010  REM * DEMO AC CONTROL ROUTINE *
1020  REM *   BY* CHUCK CARPENTER   *
1030  REM ***************************
1040 :
1050  REM  ** INITIALIZE **
1060 :
1070  REM  * SET VARIABLES TO ZERO
1080 :
1090  LET L1% = 0:L2% = 0
1100  LET L3% = 0 * L4% = 0
1110 :
1120  REM  * SET ANO TO AN3 HIGH
1130 :
1140  POKE  - 16295,0: POKE  - 16293,0
1150  POKE  - 16291,0: POKE  - 16289,0
1160 :
1170  REM  ** SET TEST LIMITS **
1180  HOME
1190  PRINT : PRINT "ENTER HIGH AND LOW TEST LIMITS"
1200  PRINT "----- ---- --- --- ---- ------"
1210  PRINT : INPUT "PDL-0 LOW TEST LIMIT....";L1%
1220  PRINT : INPUT "PDL-0 HIGH TEST LIMIT...";L2%
1230  PRINT : INPUT "PDL-1 LOW TEST LIMIT....";L3%
1240  PRINT : INPUT "PDL-1 HIGH TEST LIMIT...";L4%
1250 :
1260  REM   ** TEST OF SET LIMITS **
1270 :
1280  PRINT : PRINT : HOME
1290  PRINT "DISPLAY OUT-OF-RANGE TEST"
1300  PRINT "------- ------------ ----"
1310  PRINT : PRINT
1320  IF  PDL (0) < L1% OR  PDL (0) > L2% THEN  POKE  -
     16295,0: POKE  - 16296,0: POKE  - 16295,0: PRINT :
      PRINT "PDL-0 TEST LIMIT OUT-OF-RANGE!"
1330  IF  PDL (1) < L3% OR  PDL (1) > L4% THEN  POKE  -
     16293,0: POKE  - 16294,0: POKE  - 16293,0: PRINT :
      PRINT "PDL-1 TEST LIMIT OUT-OF-RANGE!"
1340  FOR I = 1 TO 1000: NEXT I
1350 :
1360  REM  ** ESCAPE ROUTINE **
1370 :
1380  REM  * CHECK THE KEYBOARD
1390 :
1400  IF  PEEK ( - 16384) > 127 = 1 GOTO 1450
1410 :
1420  REM  * RESET THE STROBE
1430 :
1440  POKE  - 16368,0: GOTO 1280
1450  POKE  - 16368,0
1460  HOME : PRINT "END OF AC CONTROL TEST PROGRAM.....
     "
```

Listing 3.

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Cart, cont'd. . .

Apple Turn-on with Easy I/O

For the circuit tinkerer, here's an idea for turning things on and off with your Apple. The circuit diagram in Figure 1 and Program Listing 3 illustrate a simple AC circuit controller using the Easy I/O connections on the game paddle socket. This circuit and control program can be used to control low power AC devices. Up to 4 circuits are possible but only one will be shown here. Since they are all identical, just add as many more as you want. And this is not the only circuit possible. By using some of the integrated circuit (IC) devices now on the market you can use the 4 single bit output ports (AN0 to AN3) to control up to 16 devices. More on that later.

About the Circuit

A 555 IC is used to provide a timed pulse to the transistor driver. The solid state relay is used to control the AC device. Input to the 555 is provided from the game paddle connector pin 15. This is the AN0 port. Ports for AN1 to 3 are also available. A pulse of short duration is generated at pin 15 from a Basic program and this pulse in turn creates a longer pulse. The components connected to the 555 provide a 2 second output pulse in this circuit. By changing either R1 or C1, the timing of the pulse can be changed. For instance, if the resistor R1 were changed to 500K, the output pulse duration would be around 5 seconds. Should you choose to drive the circuit direct from the AN0 port, just leave out the 555. Then you need to change the direction of the driving voltage. Instead of the short negative going pulse, you would use a constant positive voltage. Again, your Basic program would provide the controlling signal. The dotted line shows the connection to make if the 555 is not used. With a direct connection to the transistor driver, you can turn the AC relay on for any length of time you choose.

About the Program

Listing 3 is a short program to illustrate using the AC control circuit. This program provides a short output pulse to AN0 and AN1. The game paddles are used to provide the control signals. These signals could just as easily be a temperature measuring device or other variable voltage source into the PDL(0) and PDL(1) ports. (Same for the other two game paddle ports too.) For demonstrations though, the game paddles are easily accessible. By setting up a range of high and low test voltages, a pulse is generated when the 'window' is exceeded on either end.

Lines 1050 through 1150 are used to initialize the variables and to set the ports high. Integer variables were used as represented by the % symbol. The pokes used represent the address of the output ports. These addresses set the voltages to the high value. Using an address represented by a higher number (absolute value) will set the ports to the low value. You can see this in lines 1320 and 1330 where the voltage goes from high to low and back to high with the pokes used. It may not be necessary to initialize these levels since they are used in the generation of the pulse. However, I like to know where I am starting.

Test limits are set in lines 1190 to 1240. Since the output range is 0 to 255, a test window range between these limits is selected. In the sample run, the low limit is 20 and the high limit is 200. For closer control, set the limits closer together. The limits can be skewed toward either end, too. Lines 1320 and 1330 are used to test the output values. If the window limits are exceeded, a short pulse is generated to the control circuit. This pulse triggers the 555 IC and a 2 second pulse is generated to drive the solid state relay. If you wanted to use the direct connected circuit, then you would want to change the poke sequence to drive the voltage high to activate the relay. Then at some other point in the program, poke the voltage back to low to turn the relay off.

As long as you don't press any keys on the keyboard, the program will continue to loop and test input voltages. A delay loop is included in line 1340 to prevent flicker on the screen. To escape from the program, lines 1400 to 1450 test for the pressing of a key and reset the keyboard strobe. And, line 1460 ends it once a key is pressed.

I've used this control circuit and program for machine control. The possibilities for home control and game playing responses are numerous. As I mentioned at the beginning of this section, you can use other IC's for control of several devices. A 74150 TTL IC will provide control signals for 16 outputs. With the input connected to the 4 output ports — connected in binary coded decimal — you can generate pokes to turn any one of the 16 outputs on or off. The *TTL Cookbook* by Don Lancaster (Sams 21035) is a good source of information on TTL applications.

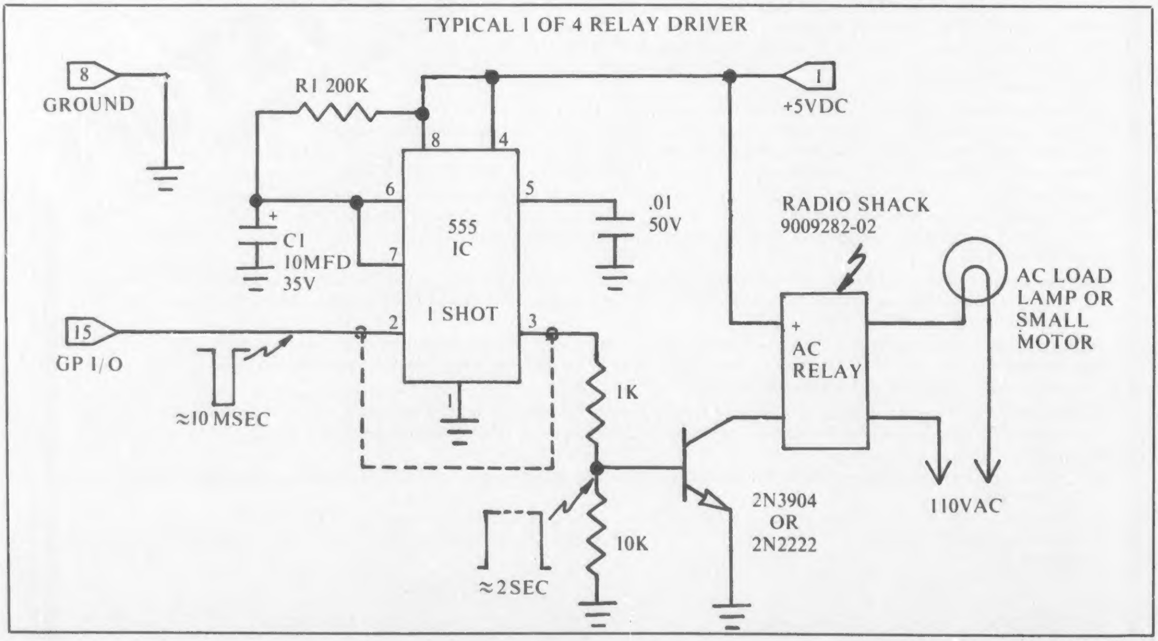

Figure 1.

```
RUN

ENTER HIGH AND LOW TEST LIMITS
----- ---- --- --- ---- ------

PDL-0 LOW TEST LIMIT....20

PDL-0 HIGH TEST LIMIT...200

PDL-1 LOW TEST LIMIT....20

PDL-1 HIGH TEST LIMIT...200

DISPLAY OUT-OF-RANGE TEST
------- ------------ ----

PDL-0 TEST LIMIT OUT-OF-RANGE!

PDL-1 TEST LIMIT OUT-OF-RANGE!

DISPLAY OUT-OF-RANGE TEST
------- ------------ ----

DISPLAY OUT-OF-RANGE TEST
------- ------------ ----


PDL-0 TEST LIMIT OUT-OF-RANGE!

DISPLAY OUT-OF-RANGE TEST
------- ------------ ----

PDL-1 TEST LIMIT OUT-OF-RANGE!
END OF AC CONTROL TEST PROGRAM.....

]
```

Example Run of AC Control Test

MicroNET

MicroNET is a personal computing service that you can access from your personal computer. If you have the communications card and an acoustical modem or the D.C. Hayes Modem, you can have access to a large-scale computer. Several programming languages are available including Pascal and APL and, since this is a DEC-based system, several DEC languages. In fact, those of you familiar with DEC systems will find the command syntax very familiar.

A variety of services in addition to languages are provided. Some of these include:

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CIRCLE 123 ON READER SERVICE CARD

Personal Electronic Transactions

by Gregory Yob

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I am happy to hear from you, and encourage your correspondence. I will try to acknowledge all correspondence, and a SASE makes things easier for both of us. Please send your letters to "Personal Electronic Transactions" c/o PO Box 354, Palo Alto, CA 94301.

Oh My Gosh, A Bug!

Hand-typing listing has its hazards as Ora Flanigam recently reminded me. When he used the formatting program in the Jan. '80 column it didn't work for negative numbers or values less than 0.01. The cure was to change Line 9050 to:

```
9050 R$=MID$(R$,1,1)
```

This made all the bad stuff go away. If you find a bug, let me know! I am happy to print corrections and mention who found them.

Ora also inquired re cassette files. I have done several articles on the PET for KILOBAUD Microcomputing, and for your reference here is a list:

1. PET Techniques Explained, January 79, Page 82. This article covers cassette tape data files.
2. PET User Port Cookbook, March 79, Page 62. All you ever want to know about the User Port.
3. Get Your PET on the IEEE 488 Bus, July 80, Page 22. A three-part article (July, August, September 80) covering the IEEE 488 bus in detail.

You will notice that this series comprehensively covers the PET Input and Output methods.

A Word Processor

I am one of those rare persons who can write the final draft of an article on the first try (That's how these columns are made) and I have no need for form letters or other repetitious written material. As a result, I have paid little attention to the various word processors on the market, such as the WORDPROs from Commodore. Many of my friends work through several drafts and find word processors an invaluable aid. A B Computers (155 E. Stump Rd., Montgomeryville, PA 18936) sent me their Paper-Mate Command 60 (Written by Michael Riley) for evaluation and I must say I rather like it. Care is taken to permit the various keyboards/character ROM combinations, and you may redefine the keyboard to suit your preferences. (Did you know that the QWERTY keyboard we all use is one of the *worst* arrangements? 70% of the typing is done via the left hand, and studies show that a random selection of letters work better re speed and accuracy.)

I do not wish to bore you with a list of the commands — some 60 are available and will merely say that the price is right! ($29.00). PaperMate will work on any 16 to 32K PET, and though having a disc is convenient, cassette I/O will work with this product as well.

The disc I received contained several documentation files, including the complete manual and some product announcements. Taking a look at these is very helpful in seeing how this system works for printing the text files. As I said, it looks pretty good.

While Waiting for that PET Manual

A long time ago I mentioned a series of workbooks by TIS for beginners learning about the PET. This series is now consolidated into one book with some updates and additional information concerning the differences between the two Basic ROMs currently in use. (*Not* Basic4 however) If you are new to your PET, the TIS book will help a lot. (TIS, PO Box 921, Los Alamos, New Mexico, 87544. Cost: $14.95 + $2.00 for shipping.)

A Case of POKE

I have several requests concerning how to get the lower case letters on a PET. The magic location is 59468. My PET, now graced with the "new" ROMs, uses these values:

POKE 59468,12 — Upper Case Letters & Shifted Graphics.

POKE 59468,14 — Upper Case Letters & Shifted Lower Case.

That is to say, when 14 is in place, the shifted keys will now give lower case letters, and a few of the graphics symbols will now be different. This should also work with the "old" ROM PETS.

For some PETs, you will see exactly the reverse, that is, shifted keys will give shifted letters and unshifted keys the lower case letters. This is especially true of the PETS dubbed "business PETs". Commodore, in its typical fashion, went through the following sequence:

1. Press "A" and you get "A", press Shift "A" and get "a". This was then "corrected" to:
2. Press "A" and get "a", then Shift "A" gets "A". This was done by changing the character generation ROM. After a flood of complaints from software makers who now had *4* kinds of PETs to contend with, Commodore switched *back* to the first way.

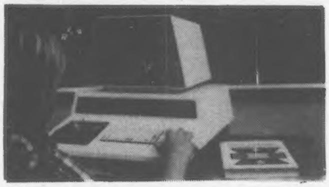
(We have yet to mention the various keyboards, that comes later . . .)

Just for fun, let's play with this feature a bit:

```
10 PRINT "clr";
20 FOR J=1 TO 40:PRINT "V";:NEXT    (Shift-V)
30 FOR J=1 TO 22:PRINT "dn";:NEXT
40 FOR J=1 TO 40:PRINT "V";:NEXT
50 GOTO 50
```

This will draw two lines on the screen near the top and bottom made of

Q. Your students are gathering around the several PET computers in your classroom. And they all are hungry for hands-on turns at the keyboards. Some students are just beginning to understand computers; others are so advanced they can help you clean up the programs at the end of the period. How do you set up a job queue, how do you keep the beginners from crashing a program, how do you let the advanced students have full access? And how do you preserve your sanity while all this is going on?



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Q. How expensive are these miracles?

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PET, cont'd. . .

connected X-like characters. Now, let's do a minor change: (Press STOP to get back from line 50.)

```
50 POKE 59468,14
60 FOR J=1 TO 100:NEXT
70 POKE 59468,12
80 FOR J=1 TO 100:NEXT:GOTO50
```

See if you like the effect! Then change the J counter in Lines 60 and 80 to FOR J=1 TO 20. Then remove the J loops in 60 and 80 entirely.

Going onward, make Line 20: FOR J=1 TO 999:PRINT"*V*"; NEXT and remove lines 30 and 40. Note the slight ripples on the screen here. Now for a tighter version of this:

NEW — to remove the old program

```
10 FORJ=1TO999:PRINT"V";:NEXT
20 A=59468:B=12:C=14
30 POKEA,B:POKEA,C:GOTO30
```

Enter this *exactly,* without any spaces at all. When this is RUN, you will see bands of X vs v moving up the screen. Basic manages to execute Line 30 about 180 times per second, or three times per each refresh of the screen. This is close enough so we can see the changing bands move comparatively slowly. If Line 30 is changed by the addition of a single space:

```
30 POKEA,B :POKEA,C:GOTO30
```

the bands now move downwards. Note that the bands move slowly enough to see that the individual scan lines of the display are changed rather than an entire line of letters. As you add more spaces between the two POKEs, the bands will move down more rapidly. If colons are used instead of spaces the effect is more drastic. (One colon is worth about 4 or 5 spaces.) This is a nice demonstration of how Basic looks at every character in a line and that extra spaces do indeed waste some time, though less than you would expect. CAUTION: If you are epileptic or sensitive to visually flickering patterns these experiments should be done with some caution. The examples given will not be harmful, but as you add spaces or colons the bands change into a flickering screen.

Different patterns will appear as you try combinations of spaces and colons. My eyes gave out before I could solve the following challenge:

The display with one space in Line 30 gives three bands of each "flavor". Modify Line 30 so the display only has two lines of each "flavor" and that they move at about the same speed. May your eyeballs ache! If you solve this, send me a copy for mention here.

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The Skyles Keyboard Program

I think all of us have grown tired of repetitively pressing the cursor movement keys when editing Basic programs and wished that an automatic repeat key function existed. Skyles Electric Works (231-E South Whisman Road, Mountain View, CA 94041) has a cassette program, BIG KBD which provides automatic repeat, Shift, Shift-Lock, and the use of the !@#$%c&*() row of keys as 1234567890 like a normal typewriter. When the program is loaded and run, a machine language program is moved to the top of your memory and "hidden" from Basic. The cost is $10.00.

When I used my copy, I noticed some differences between my home-built keyboard and what appeared on the screen. Bob Skyles mentioned that the key layout on his Big Keyboard (Available on a sale price of $99.00) and the PET's Graphics keyboard differ in a few places. The instructions for BIG KBD describe how to reassign the keys to any values you want. My homebrew "big keyboard" is a copy of the little keyboard, and PET owners with the graphics keyboard may want to make the changes mentioned below. If you own the "business" keyboard, BIG KBD will *not* work for you.

When I loaded and RAN BIG KBD, I noticed the following changes:

(I Typed)	(I Got)	(I Wanted)
"	"	2
'	7	6
&	6	7
\	.	8
*	8	*
@	2	@

In short, I wanted my "Big Kbd" to look like the PET keyboard except for the numbers placed along the top row. The same changes were evident when the Shift Lock option was on.

To save you some trouble, use the following procedure to modify your BIG KBD. If you get it right, the changes above will be in place.

1. Reset the PET, and then LOAD BIG KBD. Do *NOT* RUN.

2. In direct mode, enter these lines:

```
POKE 2983+34,50: POKE 3239+34,50
POKE 2983+39,54: POKE 3239+39,54
POKE 2983+38,55: POKE 3239+38,55
POKE 2983+92,56: POKE 3239+92,56
POKE 2983+42,42: POKE 3239+42,42
POKE 2983+64,64: POKE 3239+64,64
```

3. Now, RUN the program and take note of how to turn the program off for tape I/O. Load or SYS to the machine language monitor and save the program as instructed in the instructions sheet. For example, my PET has 20K of memory, and to start BIG KBD my SYS is 19610. This works out to 4C9A in hex, and the Monitor Save becomes: S "BIG KBD-YOB",01,4C9A,5000.

Be sure you have BIG KBD turned off when you try the Save!

A few other changes exist, and the general procedure goes like this: Find the PET ASCII value of the key you want to change, for example, "A" is found by PRINT ASC("A"). (Note, the quote mark " is 34.) Then find the PET ASCII value of the value you want the key to become. Then compute the POKE you want according to the instructions that Bob Skyles gives you. If you find this confusing, drop me a note.

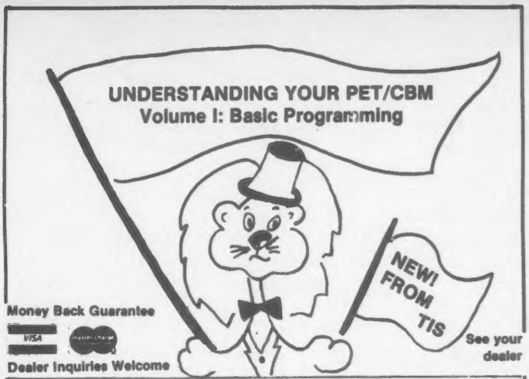
On Machine Language

When this column started, *Creative Computing* asked me to not get involved with "bit-fiddling" and other esoterica which are confusing to most PET owners. Though this is very reasonable, now and then some neat things can be done in machine language, and I'd like to share some of them with you. The way I intend to do this is to give you Basic programs which load short segments of machine language into the Second Cassette Buffer and simply used for their wonderful effects. I will explain the effects and will *not* explain how they really work. Those of you who can hack 6502 code are welcome to dissect these and see how they tick. For the rest of us, these morsels will remain black boxes to be simply used.

When converting a machine language program into the POKE values for Basic, I have found the following program very helpful. In fact, of all the programs I have written, I have used this one the most.

The program works by PEEKing the memory for the machine language and then building some DATA statements for the POKE values. When all of the statements are finished, you enter them by pressing RETURN. This is repeated until the entire machine language program is converted and then the program lists its own line numbers for your erasure, again by pressing RETURN. The result is a block of DATA statements holding the machine language.

```
10 PRINT"clr DATA MAKER FROM MACHINE LANGUAGE"
    :INPUT"dn START ADDR, END ADDR";S,E
20 INPUT"dn FIRST LINE #, INCREMENT";F,I
    :GOTO 40
30 READ F,I,S,E
40 PRINT"clr PRESS 'RETURN' TO ENTER DATA"
    :PRINT"dn dn";
```



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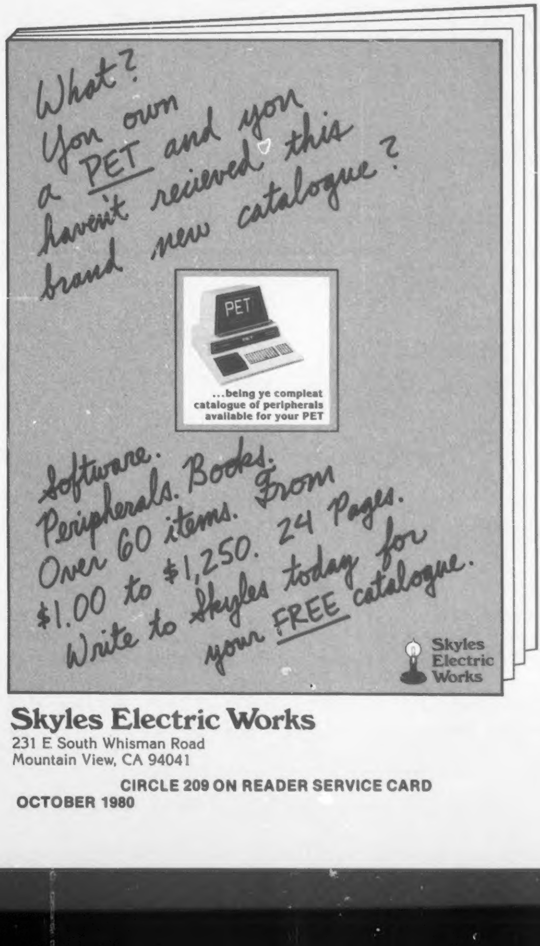

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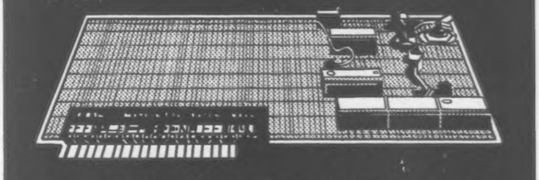

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PET, cont'd. . .

```
50 FORL=1TO20:PRINT F"DATA sp";:FOR D=1
     TO7:PRINT MID$(STR$(PEEK(S)),2);
60 S=S+1:IF S>E THEN 100
70 IF D=7 THEN PRINT:GOTO 90
80 PRINT",";:NEXT D
90 F=F+I:NEXT L:PRINT"RUN 30 hm dn dn
     110 DATA"F","I","S","E"hm";:END
100 PRINT:PRINT"RUN 120 hm dn";:END
110 DATA 1000 , 1 , 826 , 900
120 PRINT"clr PRESS 'RETURN' TO REMOVE
     NON-DATA dn": FOR J=10 TO 130 STEP 10
     :PRINT J
130 NEXT J:PRINT"dn";:END
```

Ugly little monster, isn't it? We make use of what I call "screen gymnastics", or printing Basic lines on the screen and then positioning the cursor so your press of RETURN will enter these lines. Advanced programmers can eliminate the press of RETURN by poking 13, the value for RETURN, into the keyboard input buffer. I prefer to see what's happening and press RETURN manually.

Lines 10 and 20 announce the program's existence and ask for the line numbers and addresses needed. For example, the values 1000,10 and 826,900 will start the DATA statements at 1000 in intervals of 10 (1000, 1010, 1020, etc.) and convert addresses 826 through 900 into DATA. Line 40 prints an instructional line on the cleared screen and line 50 does all of the work.

The line number, F, is printed and then the keyword DATA. The D loop then looks at 7 memory locations and prints their values. I decided that the DATA statements should fit on one screen line, and the worst case, 9999 DATA 255,255, 255,255,255,255,255 will only permit the 7 bytes. Of course your first line number should be larger than 130 to avoid collisions with the program itself. The string expression looks at memory, converts the PEEK number to a string, and the MID$ function is used to remove the blank that always appears at the start of a printed number. Line 60 checks that the location S is within the address range, and Line 70 checks if we are at the seventh byte. This late byte needs a PRINT statement to get to the next line on the screen. Line 80 provides the comma between the numbers in a DATA statement and ends the D loop.

Line 90 adds the interval, I (letter i) to F, the line number and terminates the L loop. L counts the number of lines on the screen and stops everything if a screen full of DATA statements is ready for your entry. When this happens, we land at the second part of Line 90 where the lines:

```
RUN 30
110 DATA .....,.....,.....,.....
```

are placed on the screen in the correct positions.

The program now stops and the cursor is placed on the DATA statement 110. 110 contains the current information to permit a re-run of this program. As you press RETURN, eventually the RUN 30 is entered.

A look at Line 30 shows that the DATA in Line 110 re-enters the program for the next page of DATA. This repeats until the test in Line 60 says we are done. Line 100 is now entered, and the screen display only shows the DATA and a RUN 120. Again, pressing RETURN gets us to Line 120. Now the values 10 to 130 appear on the screen, and by pressing RETURN, the program itself is eliminated. If you do a LIST, only the DATA statements appear. You may now enter your program in the normal manner.

Machine Language Goodie #1

When Darth Vader is approaching and the good ship Twimbly is stricken with a laser blast, you need a good effect to let the captain know something just happened. This little goodie reverses the video for all of the screen. Voila:

```
10 FOR J=826TO858:READB:POKEJ,B:NEXT
20 INPUT "clr INTERVAL";I
30 PRINT"clr COUNTING"
40 FOR J=1TO20*RND(1)
50 PRINT". sp";
60 FOR K=1TO1000:NEXT:NEXT
70 FOR J=1TO20:SYS826
80 FOR K=1TO10*I:NEXT:NEXT
90 GOTO 20

1000 DATA 169,128,141,72,3,141,77
1010 DATA 3,160,4,162,0,189,0
1020 DATA 128,73,128,157,0,128,232
1030 DATA 208,245,238,72,3,238,77
1040 DATA 3,136,208,234,96
```

Line 10 loads the program held in the DATA lines to the second cassette buffer. The screen clears and you are asked for an INTERVAL which controls the time between "screen flips". The rest of the program gives a little drama to this event. Try 10 for the INTERVAL value at first.

Machine Language Goodie #2

Here is a minor variation on Goodie #1. It isn't useful, but is fun to look at.

```
10 FOR J=826 TO 862:READB:POKEJ,B:NEXT
20 FOR J=0 TO 255:SYS 826
30 FOR K=1 TO 200:NEXT:NEXT

1000 DATA 169,128,141,72,3,141,77
1010 DATA 3,160,4,162,0,189,0
1020 DATA 128,73,0,157,0,128,232
1030 DATA 208,245,238,72,3,238,77
1040 DATA 3,136,208,234,238,74,3
1050 DATA 96,0
```

Once this program is entered, clear the screen, do a LIST, and then RUN. As a challenge to the hackers, see if you can figure this one out *without* doing a disassembly!

More Quickie Programs

Thanks for some more "quickie" programs, and please keep sending them in! The Decimal/Hex problem has brought many replys of which I share two:

Matt Ganis & Fred Covitz gave me this little goodie which converts a decimal number to both Hexadecimal and Binary forms:

```
10 W$="123456789ABCDEF":INPUT NU:
     N+NU:FORT=3TO0STEP-1:A=16↑T
20 IF N/A=>1THENWV%=N/A:H$=H$+
     MID$(W$,WV%,1):N=N-WV%*A:GOTO35
25 H$=H$+"0"
35 NEXTT:D=NU:FORT=15TO0STEP-1:
     A=2↑T:W=D/A:IFW=>1THEND=D-A
     :B$=B$+"1":GOTO45
40 B$=B$+"0"
45 NEXT
50 PRINTNU;TAB(8)H$;TAB(17);B$
     :CLR:GOTO10
```

When entering this monster, pay attention to the line numbers! The valid numbers are from 0 to 65535.

David Harris claims that this hex-to-decimal program takes the least amount of memory for program and storage:

```
10 G=16:A$="0123456789ABCDEF"
20 INPUTH$:FORI=1TOLEN(H$):FPRJ=1TOG
     IFMID$(H$,I,1)=MID$(A$,J,1)THEN
     C=C*G+J-1
30 NEXTJ,I:PRINTC:C=0:GOTO20
```

This works for numbers from 0 to FFFFFFF, quite a range! However, David isn't quite correct re size. By changing the NEXT in Line 30 from NEXTJ,I to NEXT:NEXT one byte may be saved. Two more bytes may be saved by another change to Line 30. (Hint — look at the last two statements.)

Dan Rubis sent this exotic program:

```
1 INPUT"MM,DD,YYYY":M,D,Y:K=INT((60+(100
    /M))/100):X=365
2 F=X*Y+D+31*(M-1)-INT(.4*M+2.3)*(1-K)+
    INT((Y-K)/4)-INT(.75*(INT((Y-K)
    /100+1))
3 W=F-INT(F/7)*7:D$="SATSUNMONTUEWEDTHRFRI"
    :PRINTMID$(D$,W*3+1,3):GOTO1
```

When I ran this, the dialog was:

```
MM,DD,YYYY? 4,28,1980          (28 April 1980)
MON                            (was indeed a
                                 Monday)
```

Dan explains that a brief formula, Zeller's Congruence, determines the day of the week from the day, month and year numbers for any dates after 1582, which was when our calendar was last adjusted. □

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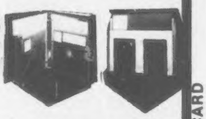

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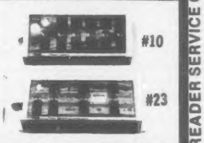

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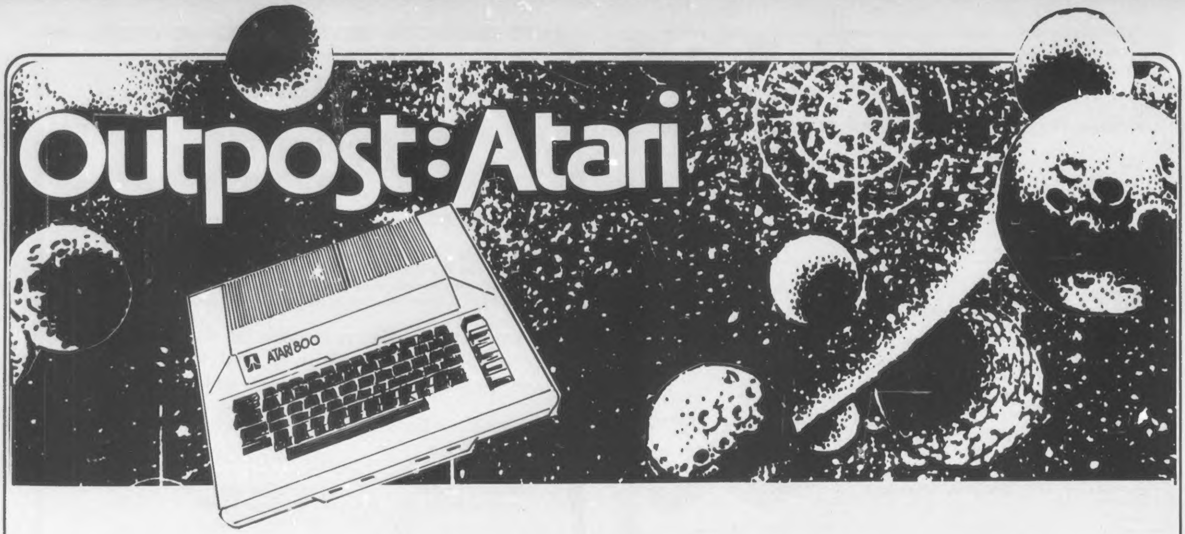
Outpost: Atari



George Blank

View from the Outpost

Our favorite computer is rapidly developing a strong following. Atari's obvious quality, excellent dealer support, serviceability, and the rapid introduction of programs and peripherals are convincing people that it is the best of the current lot of personal computers. The Software Exchange recently ran a poll in its catalog and found that of the people considering the purchase of a computer, about 75% were considering the Atari, while no other brand even came close. Apple had about 25%, and the TRS-80 about 5%. The figures add up to more than 100% because many people were considering more than one computer. Who would believe, after watching the other personal computers over the past three years, that Atari would produce so much good software so fast?

New peripherals announced include a dual double density floppy disk for $1495. This one unit has the same storage as four single drives, and you could even chain four units for 1.3 Megabytes of disk storage. Other significant new products include two printers, one very inexpensive one with thermal paper and good graphics, and the other with a high quality dot matrix print that I consider good enough for writing letters at a price of $995. There is also an expansion unit for connecting a modem or parallel or serial printer, and a terminal ROM cartridge for connecting your Atari to a time sharing computer.

I sympathize with the busy folks at Atari who are producing and supporting all these products. I have already collected over 1000 pages of preliminary documentation, and I don't see how they even produced it, much less how they can edit and publish it. If you are still lacking essential information about your computer, just be patient. A flood of information has been released, and if Atari doesn't get it out soon, the magazines will.

String Array Demonstration

Gordon Link of Rochester, New York wrote to ask if I would say more about using string arrays and demonstrate how to do it. I hesitate to do it, because I am sure that by the time this column appears, my present technique will appear clumsy, but here is a sample program. If you make major improvements in efficiency, let me know, and I will pass the technique along.

```
10 GR.0 : REM * STRING ARRAY DEMONSTRATOR *
100 DIM A$(10) : DIM B$(10) : DIM C$(100)
110 FOR D = 1 TO 10
120 A$="          " : READ B$ : A$(1,LEN(B$)) = B$
130 C$(D * 10 - 9 , D * 10) = A$
140 NEXT D
150 DATA Zero,One,Two,Three,Four
160 DATA Five,Six,Seven,Eight,Nine
200 PRINT"TYPE A NUMBER FROM 0 TO 9?"
210 INPUT E
220 IF E<0 THEN 210
230 IF E>9 THEN 210
240 PRINT C$(D * 10 + 1 , D * 10 + 10)
250 GOTO 200
```

It is necessary to insert ten spaces in the holding string (A$) in line 120 for two reasons. First, if you run the program without it, you will end up with little hearts filling in the space after your letters. Second, the Atari only considers a string dimensioned as far as data has been inserted into it, even if the DIM statement reserves more space. Without the spaces to fill up locations 95 to 100 in C$, the computer will crash with a string dimension error in line 240 if you type in a 9.

This means that if you use strings of random length and store them in a fixed array, you must be careful to pad any trailing blanks with spaces. This creates a new problem. If you want to use your strings without the trailing blanks, you must strip them off. One method is to start at the end of the string and test until you find a character that is not blank. This demonstration program will show how.

```
10 GR.0 : DIM A$(10) : DIM B$(10)
20 A$ = "TEST      "
30 C = LEN(A$)
40 IF A$(C,C)=" " THEN C=C-1 :
   GOTO 40
50 B$ = A$(1,C)
60 PRINT"THE WORD IS ";C;" LETTERS
   LONG"
70 PRINT A$;A$;A$;A$
80 PRINT B$;B$;B$;B$
```

Of course this routine would crash if the string were all spaces, but it is easy to limit C to 1 if you need to do that.

Input/Output (casual readers beware)

Another reader, Arthur McGraw of Whitehall, Ohio, sent in a circuit diagram for an inexpensive light sensor. Atari has a light pen available for $75, but you experiment with the same principle for a few cents (See Figure 1).

This particular circuit was used to track the intensity of the sun throughout the day. The parts needed are a cadmium sulfide photo cell and a capacitor. The capacitor extends the range of the converter.

George Blank, Foster Road, Milford, NH 03055.

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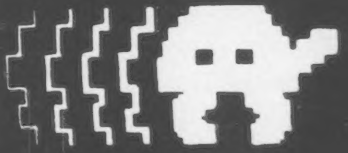

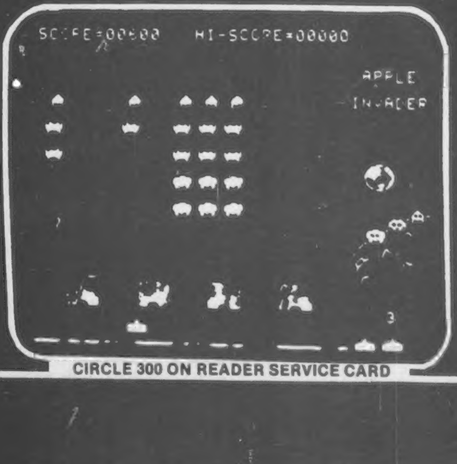

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Atari, cont'd. . .

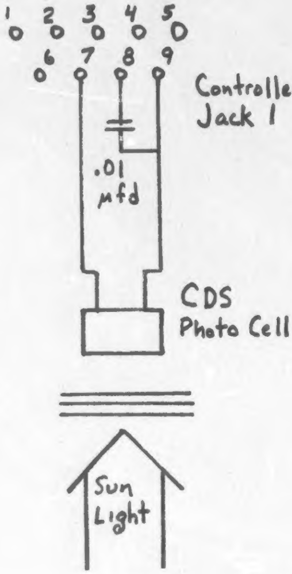

Figure 1

Pins 1 to 4 of each of the 4 controller jacks are connected to a 6520 peripheral interface adaptor. Jacks 1 and 2 are connected to Port A at memory location D300 (hexadecimal) and jacks 3 and 4 are connected to Port B at D301. The control register is located at D302 for Port A and D303 for Port B. If the appropriate bit in the control register is a 0, you access the direction register for the port. Set the direction bits to 1 for output and 0 for input. Then set the control register bits to 1 to access the port instead of the direction register. Here is a sample program to show how to use the ports (Figure 2).

Printer Interface

Macrotronics has taken advantage of the joystick ports to provide an inexpensive printer interface. They provide a tiny circuit board that includes only two connectors and eight transistors to plug into controller ports 3 and 4. A ribbon cable leads to the printer connector, with three connectors available; Trendcom, Centronics 730 series, and other Centronics. Because the ports are spaced differently, you must specify whether you want the interface for the Atari 400 or Atari 800.

Software is provided on cassette tape to enable you to operate the printer. The software is easy to use, with detailed instructions for using it to modify your disk operating system to route all printer output to the interface. If you are using cassette tape, you will have to load the program separately each time you want printed output. The program is unsophisticated in other respects. I wanted to produce line listings for *SoftSide* magazine in forty column format instead of eighty column format, but will have to write my own print driver to do it.

At $69.95, the interface is a good alternative to Atari's more complete expansion interface at $219, and it does allow you to use most parallel printers. The only difficulty I had was in determining which way to plug the cable into the printer. The package also includes a banner demonstration program.

Programmer's Aid

The Atari suffers from a problem common to all other personal computers that are designed to connect to a standard color TV set. It is not easy to read the letters on the screen. The reason for this is that television sets contain a trap that limits the amount of information that can be scanned each second. This is done to allow many different television stations to share small parts of the electromagnetic spectrum. However, it limits the amount of information your computer can send to the screen to a rough display of less than 1000 letters unless you modify the TV, and a computer that requires you to modify your television set might not be popular.

One device that I have found very useful for making the letters readable is the Green Window, available from several suppliers for $19.95. This green plastic filter fits over the front of the TV set and makes the letters easier to read. I just tape mine on when I am programming, so that I can take it off when I am working with color or playing a game.

I have tried cheaper products that do the same thing, such as the Green Screen, but they are not as good. While the Green Window is hard plastic, about ¼ of an inch thick, the others are made of flexible plastic film that bends and reflects light in distracting patterns. The others also do not seem to offer as much contrast.

Atari's Editor-Assembler

Atari was kind enough to lend me an advance copy of their editor/assembler for evaluation. I did not have the final version, but an EPROM cartridge with a photocopy of a rough draft of the manual, so some features may change.

The package includes several parts to make a convenient assembly language development system. In addition to the Editor and the Assembler, there is also a Debugging monitor and a Mini Assembler. The manual noted that users are expected to be familiar with 6502 assembly language. If you are not, you will need a course or book such as Programming the 6502 by Rodnay Zaks of Sybex.

The first program in the package is the Writer/Editor. This allows you to enter your programs, correct errors, and access the disk operating system to save your programs. While it is possible to save your programs on cassette, the package assumes that most users will have disk systems. The editor includes handy functions such as "SIZE", which tells you the starting location in memory of the current line buffer, the start of the edit text buffer, and the highest available location in memory.

The second program is the Assembler. This takes your assembly language program and turns it into numbers that the computer can understand. For example, you might want to load the number 0 in the accumulator to prepare it for an arithmetic operation. The accumulator is a storage location in the actual computer chip that holds a value to be operated on. Using the editor, you would enter your "source program" (in assembly language, using the instruction) LDA #0. When you run the assembler, it would look at that instruction and create an "object program" (of numbers for the computer.) Our LDA #0 would be converted into the numbers 169, 0. The number 169 tells the computer to LoaD the Accumulator (LDA) with the number stored in the next memory location. The 0 is the number.

LDA #0 is assembly language, and it is fairly easy for humans to understand. The numbers 169, 0 are machine language, and are easier for the computer to understand. The purpose of the assembler is to make things easier for both the computer and the programmer by translating assembly language into machine language.

The third piece of the package is the debugging monitor. Since computers never make mistakes, and people always do, Atari thoughtfully provided this program to help you find out where you went astray. Among other things, the

Figure 2

```
10 POKE 54018, 255 : REM Point Control Register A
                     to Data Direction Register A
20 POKE 54016, 0 : REM Set Port A (Jacks 1 and 2)
                   for data input
30 POKE 54018, 0 : REM Point Control Register A
                   to I/O port A
40 X = PEEK(54018) : REM Set variable X to input value.
50 POKE 54018, 255 : REM Point Control Register A
                     to Data Direction Register A
60 POKE 54016, 255 : REM Set Port A for data output
70 POKE 54018, 0 : REM Point control register A
                   to I/O Port A
80 POKE 54016, 18 : REM Data output. Sends bit pattern
                    0010 to jack one and
                    0001 to jack two.
```

monitor will let you look at memory in several different ways, single step through your program looking for your mistake, and even convert all those confusing numbers back into assembly language with a disassembler.

The final program in the package is the mini-assembler. Just like an assembler, the mini-assembler converts assembly language into machine language. The difference is that it does it one instruction at a time, as you enter the command, without the features of an editor.

I have never used another 6502 assembler, though I have programmed in Z-80 and 6800 assembly language. I found the Atari package convenient and easy to use, and I really appreciated the built in monitor, debugger, and disassembler. There were only two things I did not like. First, it was difficult to program on a screen that is only 36 characters wide. I would personally prefer 72 characters, so that I could include enough comments on my code to understand it the next time I see it without cluttering up the display. The other shortcoming is the lack of a symbol table in the assembler output. A symbol table would be very desirable, as it is a nuisance to look for a label in the listing of a long program. I consider the program well worth the $59.95 price. □

```
10 GR.0 : REM * STRING ARRAY DEMONSTRATOR *
100 DIM A$(10) : DIM B$(10) : DIM C$(100)
110 FOR D = 1 TO 10
120 A$="          " : READ B$ : A$(1,LEN(B$)) = B$
130 C$(D * 10 - 9 , D * 10) = A$
140 NEXT D
150 DATA Zero,One,Two,Three,Four
160 DATA Five,Six,Seven,Eight,Nine
200 PRINT"TYPE A NUMBER FROM 0 TO 9?"
210 INPUT E
220 IF E<0 THEN 210
230 IF E>9 THEN 210
240 PRINT C$(D * 10 + 1 , D * 10 + 10)
250 GOTO 200
```

```
10 GR.0 : DIM A$(10) : DIM B$(10)
20 A$ = "TEST      "
30 C = LEN(A$)
40 IF A$(C,C)=" " THEN C=C-1 : GOTO 40
50 B$ = A$(1,C)
60 PRINT"THE WORD IS ";C;" LETTERS LONG"
70 PRINT A$;A$;A$;A$
80 PRINT B$;B$;B$;B$
```

```
10 POKE 54018, 255 : REM Point Control Register A
                     to Data Direction Register A
20 POKE 54016, 0 : REM Set Port A (Jacks 1 and 2)
                     for data input
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70 POKE 54018, 0 : REM Point control register A
                     to I/O Port A
80 POKE 54016, 18 : REM Data output. Sends bit pattern
                     0010 to jack one and
                     0001 to jack two.
```

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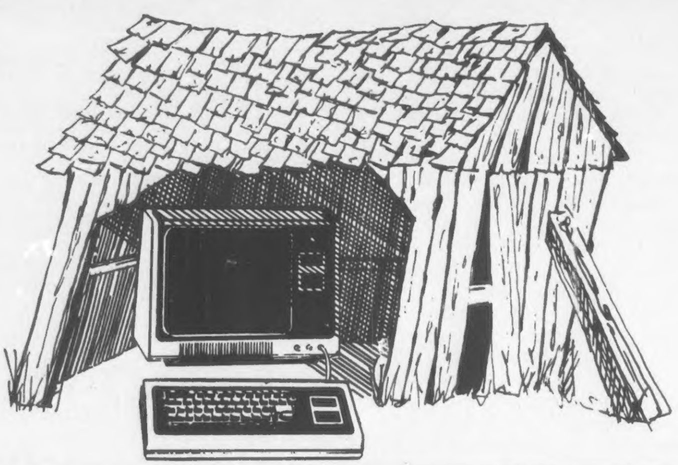
CIRCLE 217 ON READER SERVICE CARD

TRS~80 Strings

Stephen B. Gray



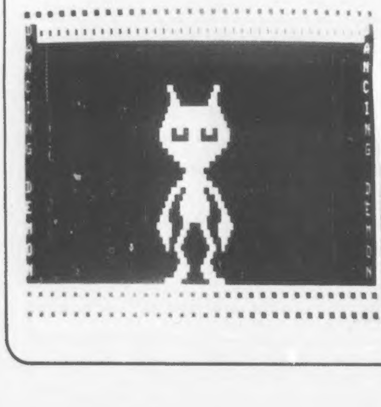
For number 23 in this skein of TRS-80 columns, we have a bunch of Radio Shack items: an animated tap-dancer with music, a music-playing program, animation program, network controller, educators' package, and double-precision math program. Then we find CLOAD magazine has dropped Level I programs, and that there are many more than the 60 file names I said could be used on cassette.

Dancing Demon

On the same day I sent to Morristown the September 1980 TRS-80 column, containing an item about James Williams' ORGAN program being perhaps the only real-time organ program for the TRS-80 and also requiring no programming, I received Radio Shack's Dancing Demon in the mail.

This has got to be Leo Christopherson's best so far: an incredible 16K Level II program that lets you write the music and choreograph the dance for a 3¾ inch high "dancing demon," who tapdances remarkably well.

Load the program and RUN it, and a "demon" (looking something like a long-legged human wearing a round face mask with ears on top, but no nose or mouth), dances a few steps and takes a bow, as an introduction to the program.



The demon dances atop these words:

PROGRAM BY
LEO CHRISTOPHERSON

which makes this one of the first Radio Shack programs whose author is identified.

("We're starting to do that," said Van Chandler, Radio Shack's director of computer applications. "Authors like the recognition, and it doesn't hurt anything. It's also a good negotiating tool." This then is a softening of Radio Shack's previously monolithic pretense that they wrote all the software and made all the hardware.)

Next a menu appears, giving you the option of playing one of two "preset" shows, entering a new musical score or dance routine, playing a new or loaded show, saving a new show on tape, or loading a show from tape.

The pre-programmed shows are samples that demonstrate what can be done, with the demon tapdancing to "Ain't She Sweet" and to "The Gypsy's Warning."

The demon executes quite a variety of steps, from simple time-steps to turns and jumps, and with hands moving up, out, and down.

If you want to write a new tune, you get a display that shows which keys represent which notes in a two-octave scale with sharps and flats, in a simple equivalence table. You can enter up to 248 notes, and either press CLEAR to start again, or use the back-space arrow to correct as many mistakes as necessary.

As you press keys, they're displayed one after another as letters at the top of the screen, and the corresponding notes are played at the same time, either through a hi-fi system connected to the plug that usually connects to the cassette recorder's AUX jack, or to Radio Shack's $11.95 "200mW amplifier-speaker," catalog number 277-1008A, which has a two-inch speaker and is entirely adequate for most audio applications of this type. (You can also use this Realistic Micro-Sonic Speaker-Amplifier with a microphone or a telephone pickup, or add a probe and use it as a signal tracer.)

After you've entered some of your tune, and the top of the screen shows something like

HHJLHLJCHHJLHZG

you just press the space bar and you'll hear "the score up to now." This very clever feature lets you check out what you've done, and make any necessary corrections before going on. (The 15 letters above play the beginning of "Yankee Doodle," with Z creating a pause.)

The high point of the program is when you enter the Dance Routine. You get a display very much like the musical-score display, with a menu providing 26 routines, one for each letter of the alphabet, and with space at the top for the letters for 248 routines.

The routines include seven basic steps, two stomps, a turn, three moving steps, and three jumps (fast, slow, spin). Eight of these steps can be done either to the left or to the right. The number of beats per routine is also shown, which you need to know if you really want to make the dancing match the music.

To see what you've choreographed as you go, press the space bar, which will make the demon dance to the steps (and music) you've written so far.

When you're ready to show off your choreography and music, you can have the demon dance as he does in the two preset shows: on a stage with a curtain that raises and lowers before and after your effort, at any of 255 speeds, ranging from super-fast to slow-motion, and for as many "performances" as you wish.

One of the very few problems with this

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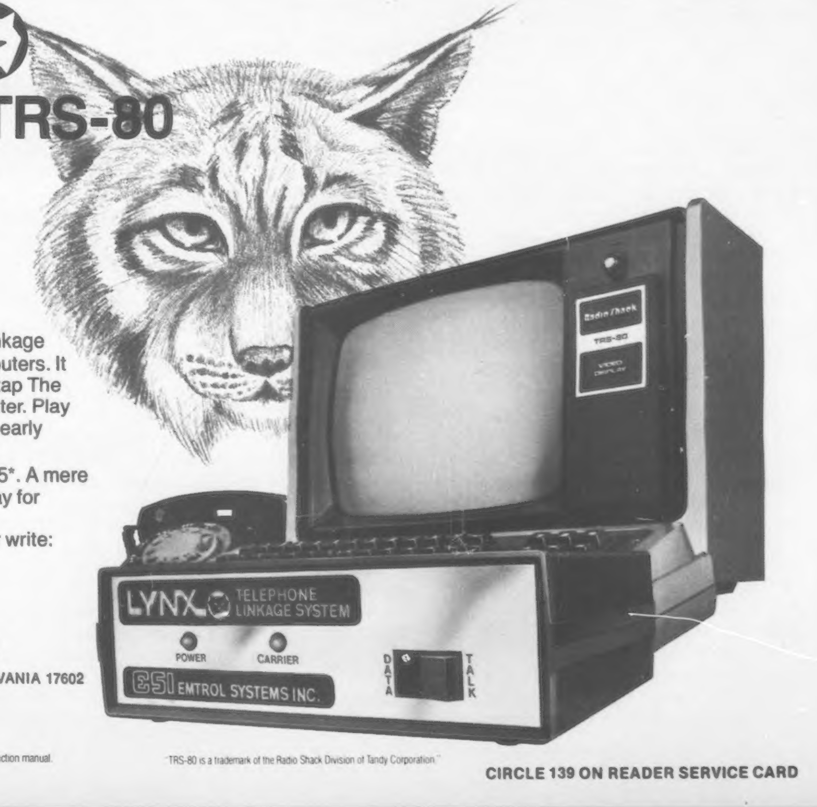

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CIRCLE 139 ON READER SERVICE CARD

program is that the musical scale corresponds to the alphabet: the low C note is played by A, middle C by M, and the top C by Y.

Williams did it much better, using keyboard keys corresponding fairly closely to the spacing of organ keys, and with the organ keyboard displayed on the screen along with the keyboard characters atop each key. With William's keyboard display, Dancing Demon would be much easier to write music for.

What fun it would be to see Gene Kelly or Fred Astaire working up tapdance routines on a TRS-80 with this program! Come to think of it, with just a little more programming, this program might be sophisticated enough to be used to record tapdance routines for a dance library or for teaching. A similar program, with more programming for an increased number of routines, might be used to record ballet steps.

For only $9.95, you too can be a dance choreographer, and even make the demon dance to your own tune! Words can't describe the great ingenuity of this program. You've got to see it to believe it.

Micro Music

Because so much of the Dancing Demon program is taken up with the complex dance routines, there are of course some limitations on just how fancy a piece of music you can write to go with the tapdancing. If it's fancy music you want to play on your TRS-80, then you should look into Micro Music, Radio Shack's $9.95 4K Level I/II program.

Micro Music allows you to write monophonically in a five-octave range, with sharps and flats, and with whole, half, quarter and eighth notes, dotted notes, and triplets. The mechanics of writing with this program are easier than with Dancing Demon, because you write a C for a C note, rather than an arbitrary letter.

To play the next higher octave, you preface the note with an upward arrow. For the next lower octave, use the downward arrow. To shift to the bass range, which lets you move down two octaves, type a Z.

Load the machine-language, type

CDEFG

record it on the blank tape supplied, then play it back, to hear the first five notes of the "normal" octave. You can eliminate the record/playback steps if you connect the plug that's usually in the AUX input of the cassette recorder to a high-fi system instead, "or to a small speaker-amplifier unit (such as the Realistic Cat. No. 277-1008A)," as the manual puts it.

Using the speaker-amplifier, you just press ENTER, and the notes are played, while at the same time the letters for the notes are displayed, one at a time, in the lower-right corner of the screen, so you know just which letter is causing which sound.

Writing music with Micro Music is very easy, and you soon get used to using the arrows to shift octaves.

Sharps are played by typing # right after the note, flats by typing — after it. For a slower tempo, put a W before whatever notes are to be played slowly; to get back to "normal" speed, use M. For a dotted note, which extends a note to 1½ times normal time, simply put a period after the note, such as C2. or C8., etc.

A "thinner" tone is achieved by typing V before the notes involved, and for an even "thinner" tone, use L. These letters seem to cut down on the overtones.

To repeat a phrase, use parentheses, such as in

(4CDE)

which plays the first three notes of a scale four times.

There are several more features that get into fairly sophisticated music-making.

The manual includes a dazzling sample of what can be done with the program and just a few lines of very simple coding. The tune is called "Fright Flight," but it is actually Rimski-Korsakov's "Flight of the Bumblebee," and when you key it in and press ENTER, it will knock your ears back.

The tune is well-suited to showing off the program's capabilities, especially since most of the notes are too short to betray their rather simple timbre. But this is a small drawback in a program well worth the money and of course not intended to provide the complex waveforms of an electronic organ.

Micro Music Surprise

My daughter Elizabeth discovered a very interesting thing about Micro Music: it ignores all characters not intended for notes or functions. She was trying to "write" a favorite tune, and when it got too difficult, simply entered her name. To her surprise, it came out as a short musical phrase.

So she entered a whole sentence, and got quite a melody out of it. What makes it all really complex, and adds to the fun, is that the program, in addition to using the letters A through G for notes of the scale, uses 10 other letters for control.

Thus when she entered her name,

ELIZABETH GRAY

she heard first the E note, then the L shifted the tone to the third or "thinnest" quality, the I was ignored, the Z shifted the scale to the bass range, so that the A played two octaves lower than usual, as did the B and E. The T speeded up the tempo for triplets, so that the G note, R (rest) and A note were played at triplet speed.

With a little imagination, Radio Shack could have run a Micro Music competition for the most meaningful short piece of prose that plays a well-known musical piece.

How about using a computer to help find suitable letter-strings or word-strings? This might make an interesting Science Fair project.

Micro Movie

If, on the other hand, you're more interested in animation than in music, you should try Radio Shack's Micro Movie, a $9.95 16K Level I/II program that "makes it easy to draw pictures on your TRS-80. With a little practice, you can do animated 'movies,'" as the manual says.

(This booklet, by the way, is a prime example of how to make a manual about as dull as possible by not including one single example of what the whole thing is about: animated movies. Not one blessed frame, not one single photo or drawing to give you an idea of what can be done with this ingenious program.)

The idea is simple: you get into Graphics Mode, and trace out a figure with a series of graphics blocks, by using eight keys to control the movement of the cursor in the eight main compass directions. Press ENTER, and the figure becomes a "frame" in your movie.

Trace out another frame, press ENTER, and you've got a second frame. And so on until you've got enough frames to create the illusion of an animated "movie."

You can shift to Text Mode if you want to put words on the frames of your movie, for titles, subtitles, word-balloons, etc.

Other features of Micro Movie permit you to choose from one of 26 speeds for any part or all of the movie, to freeze a frame on the screen, insert new frames in the middle of a movie, repeat a section of the movie up to 26 times, and with a Link Command, load a new movie from tape.

For $9.95, here's your chance to become the Walt Disney of the 1980s. The program will run in 4K, but there won't be any room for storing your frames. So you'll have to "run out and get some more memory," as this incomplete manual has it. Isn't there anybody in Fort Worth with a few dollars' worth of imagination?

Network Controller

The Network I Controller is Radio Shack's first hardware for educators. According to the 12-page manual, it is a "low-cost alternative to the cassette recorder for saving and loading student programs in your classroom. With the Network I Controller, you may connect from one to sixteen student TRS-80s (student systems) to a central TRS-80 disk system. Student programs may then be saved on the disk, and instructional programs may be loaded into the student systems from the central system reliably and conveniently."

"All sixteen systems may be loaded simultaneously, or any combination may

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TRS-80, cont'd. . .

REMOTE UNIT ACTIVE
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
INPUT SELECT
POWER
MODE
Radio Shack
NETWORK 1

be loaded at a time. If your central system has a printer, your students may have their programs printed also."

To use the controller, the "central system" should consist of a 16K Level II TRS-80, expansion interface, and one or more disk drives, operating under TRSDOS. Each student system should be a Level II TRS-80.

The central system does not have to be a disk system with an expansion interface. "However, Radio Shack recommends using the disk drive rather than the cassette recorder in a classroom setting," the manual says.

The controller looks something like the pay-TV box that sits on top of your television set. It has an Input Select knob, which is set "to the number of the student's system which is sending the program." This control is not used when sending a program from the controller.

A row of 16 LEDs indicates when a program is being transferred. "The LED for a particular student will light up when the student executes the CSAVE or CLOAD command."

Other than a power switch, the only other item on the front panel is a Mode switch, which "selects the mode in which your central system will interpret the CLOAD or CSAVE command," "MPLX if you will be using the CLOAD or CSAVE commands to transfer programs to or from student systems, CASS if you will be using the CLOAD or CSAVE commands to load and save programs on tape."

For $499, you get the controller, power supply, and 18 cables: two short ones for connecting the controller to the central system and to the cassette player (if used); and 16 cables for connecting to the student systems, including six 30-ft., six 21-ft., and four 12-ft. lengths.

Educators' Package

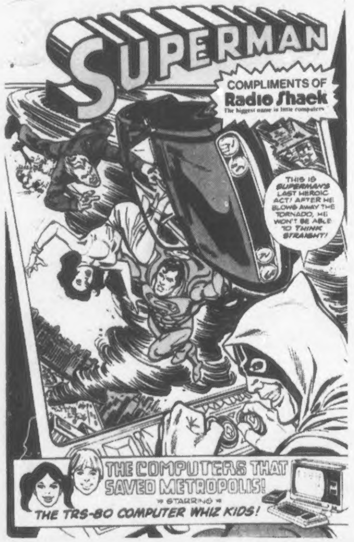
Just in case you didn't know, Radio Shack sells about 20 percent of its TRS-80 systems to schools, with a very aggressive marketing strategy that includes sending an educators' package to teachers who want to know more about using a computer in the classroom.

The educators' package consists, at this writing, of eight items: TRS-80 Microcomputer catalog, TRS-80 Microcomputer Sourcebook For Educators, Radio Shack's Federal Funding Guide And Proposal Development Handbook For Educators, My TRS-80 Likes Me (a resource guide for the elementary teacher), a comic book, and spec sheets on the Network 1 Controller, computer-education courses, and the K-8 Math Program.

A comic book? Yep, a Superman comic book, featuring a story about

THE COMPUTERS THAT
SAVED METROPOLIS!
* STARRING *
THE TRS-80 COMPUTER WHIZ KIDS

In the story, Superman tells a classroom of students about the origins of computers, leading up to the TRS-80. In the midst of his lecture, he has to leave (out the window, of course) to fight an evil nemesis who manages to make Superman's mind fuzzy with Kryptonite crystals. Superman shows two students how to use computers to perform the "instant computations and calculations" that his brain normally does, with a pair of TRS-80s. The students relay data to Superman to enable him to thwart major disasters unleashed by the evil nemesis.


SUPERMAN
COMPLIMENTS OF
Radio Shack
The biggest name in little computers
THIS IS SUPERMAN'S LAST HEROIC ACT! AFTER HE BLOWS AWAY THE TORNADO, HE WON'T BE ABLE TO THINK STRAIGHT!
THE COMPUTERS THAT SAVED METROPOLIS!
STARRING
THE TRS-80 COMPUTER WHIZ KIDS!

(The comic book is available separately, from the Advertising Dept., Radio Shack, 1300 One Tandy Center, Fort Worth, TX 76102.)

The sourcebook explains what small computers are, how to use computers in the classroom, how to select a computer and peripherals, and compares the cost of TRS-80 systems with unnamed competing systems A, B and C. The sourcebook also explains that Radio Shack offers "free training classes to teachers at Radio Shack Computer Centers from Coast to Coast," and provides a checklist of 15 reasons why the TRS-80 is the system to buy.

The item called "My TRS-80 Likes Me" is a revision of Bob Albrecht's 1970 book, "My Computer Likes Me," with eight pages showing how the TRS-80 uses Basic, including several dozen short programs using PRINT, LET, INPUT, FOR/NEXT, GOTO, RND, and graphics.

The Federal Funding Guide "addresses one of the School Administrator's most critical needs . . . how to locate external funding and write successful proposals."

The guide goes into funding sources, what publications to read to "monitor funding sources," writing the proposal, and ends with a section on "Keeping the pump primed," about what to do after you have your proposal funded.

Educators may obtain the package, whose contents vary from time to time, from William G. Gattis, Director of Educational Product Development, Radio Shack, 1600 One Tandy Center, Fort Worth, TX 76102.

Double Precision

For $9.95 you can get 15-digit accuracy on your 4K Level II machine with sine, cosine, arctangent, natural logs, exponential and square-root functions. You get eight Radio Shack subroutines that can be added to any program.

The first of the three programs on the cassette tape is called Calculator, which computes SIN, COS, LOG, EXP, ATN and SQR.

The second program is an "accuracy test of subroutines," which, just in case you had any doubts, "demonstrates the accuracy of the double-precision functions," with four examples.

The third program provides the subroutines.

The manual contains listings of all the double-precision routines, plus the accuracy test, and the calculator program.

Perhaps you're asking yourself, "But what about that double-precision stuff in the Level II manual, on page 1/4?" What the manual doesn't tell you is that the Level II Basic provides double-precision calculations in only four functions: add, subtract, multiply, and divide.

If you want to work with more than six significant figures in anything more complex than basic math, you'll need the Level II Double-Precision Subroutine Program.

Or if you have the August 1979 *Creative Computing*, you can find, on page 110, a 228-line program that provides double-precision subroutines for sine, cosine, tangent and arctangent, in both degrees and radians; logarithms and exponentials for both natural and base-10 logs; and powers.

CLOAD Drops Level I

According to the June 1980 *CLOAD* magazine (on cassette), a questionnaire sent to subscribers showed "a preponderance of Level II machines." This, plus "the lack of Level I submissions," moved *CLOAD* management to say they'd be "shifting over to all Level II programs starting with our October 1980 issue."

Several options were given as being open to Level I subscribers: upgrade to Level II 16K machines; order back issues; ask for your money back; "write us to demand that we continue Level I. Write NOW, scream HARD and LOUD."

The questionnaires also showed that "roughly half" of the subscribers "are 16K, the remainder being 32K or 48K, usually with a disk or two."

The publisher expected "that most subscribers would have purchased their computers for business purposes, as there is quite a bit of space in the various trade journals devoted to the subject. Not so — most of our subscribers fall into the fun/games and education crowd. There were few business replies, and few software development replies either." Well, only a very small percentage of *CLOAD* programs have any business orientation.

The publisher also said, "In the spread-the-disease department, there seems to be about four people introduced to computing for each TRS-80 sold. This doesn't count the computers purchased by schools, who seem to introduce computing in increments of thirty people (move over, Typhoid Mary)."

File Names

Hank Obermeyer of Newton, MA writes:

"In your May TRS-80 Strings (p 150), you said that there are 60 possible file names on cassette. There are actually many more.

"If you wish, you may use the CHR$ command for CSAVEs, such as CSAVE CHR$(191) and CLOAD CHR$(191) or any string variable or statement, although the cassette statements only look at the first character. This gives a total of 256 file names, far in excess of the 60 you mentioned." □

Computer Store of the Month

ComputerLand of Rockville

There is a movement afoot to make computer technology more accessible. Manufacturers are praised for their user-oriented hardware, programmers for their interactive software and writers for writing in English. In the midst of all this hullabaloo, computer stores are springing up in communities from Anchorage to Paris—offering hands-on demonstrations to anyone stopping in. Some humble voices suggest that this proliferation of local computer stores is the most progressive development of all.

Like most computer stores, ComputerLand of Rockville takes on the character of its community, the Washington D.C. area. Among the store's customers are government agencies, schools and universities, manufacturing firms, small businesses and hobbyists. Anyone curious about computers can stop in and ask for a demonstration. The staff prides itself on its custom of demonstrating the software and manuals available for each system in addition to the hardware capabilities. Members of the staff tackle the weighty problem of teaching people to be comfortable with computers one customer at a time.

Gameplaying is one of the best introductions to computers in existence. And Creative Computing Magazine, Book Press and Sensational Software offer the best available anywhere.

Outdoor Games, the latest release of Creative Computing Software, is a collection of adventures in the wilds...**Forest Fire** puts you in the role of a fire-fighting team leader fighting to save grasslands and forests by using fir retardant chemicals and backfires. **Fishing Trip** challenges you to bring in big catches off the Oregon Coast. **Treasure Island I and II** let you explore a hazardous haunted island to make your fortune. All four outdoor Games are available on 16K cassette (CS-4504 $24.95). Outdoor Games is available at your local retail store. If your retailer is out of stock, have him call in your order to 800-631-8112.

creative computing

the #1 magazine of computer applications and software

puzzles & problems

It's In The Cards

Let's start off with an interesting item from "Merlin's Puzzler 1" by that famous Victorian writer on puzzles, Professor Hoffmann. Although this puzzle is usually presented as a conjuring trick, it is also an effective puzzle, for it is clear that the secret must lie in the cards themselves, and, given sufficient acuteness, must be discoverable.

Prepare seven cards with numbers on them as shown below. A person is requested to think of any number from 1 to 127 inclusive and to state on which one or more of the seven cards it is to be found. Any one knowing the secret can instantly name the chosen number.

How is the number ascertained?

I.			
1	33	65	97
3	35	67	99
5	37	69	101
7	39	71	103
9	41	73	105
11	43	75	107
13	45	77	109
15	47	79	111
17	49	81	113
19	51	83	115
21	53	85	117
23	55	87	119
25	57	89	121
27	59	91	123
29	61	93	125
31	63	95	127

II.			
2	34	66	98
3	35	67	99
6	38	70	102
7	39	71	103
10	42	74	106
11	43	75	107
14	46	78	110
15	47	79	111
18	50	82	114
19	51	83	115
22	54	86	118
23	55	87	119
26	58	90	122
27	59	91	123
30	62	94	126
31	63	95	127

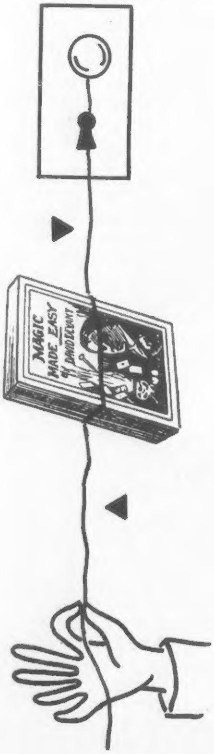
III.			
4	36	68	100
5	37	69	101
6	38	70	102
7	39	71	103
12	44	76	108
13	45	77	109
14	46	78	110
15	47	79	111
20	52	84	116
21	53	85	117
22	54	86	118
23	55	87	119
28	60	92	124
29	61	93	125
30	62	94	126
31	63	95	127

IV.			
8	40	72	104
9	41	73	105
10	42	74	106
11	43	75	107
12	44	76	108
13	45	77	109
14	46	78	110
15	47	79	111
24	56	88	120
25	57	89	121
26	58	90	122
27	59	91	123
28	60	92	124
29	61	93	125
30	62	94	126
31	63	95	127

V.			
16	48	80	112
17	49	81	113
18	50	82	114
19	51	83	115
20	52	84	116
21	53	85	117
22	54	86	118
23	55	87	119
24	56	88	120
25	57	89	121
26	58	90	122
27	59	91	123
28	60	92	124
29	61	93	125
30	62	94	126
31	63	95	127

VI.			
32	48	96	112
33	49	97	113
34	50	98	114
35	51	99	115
36	52	100	116
37	53	101	117
38	54	102	118
39	55	103	119
40	56	104	120
41	57	105	121
42	58	106	122
43	59	107	123
44	60	108	124
45	61	109	125
46	62	110	126
47	63	111	127

VII.			
64	80	96	112
65	81	97	113
66	82	98	114
67	83	99	115
68	84	100	116
69	85	101	117
70	86	102	118
71	87	103	119
72	88	104	120
73	89	105	121
74	90	106	122
75	91	107	123
76	92	108	124
77	93	109	125
78	94	110	126
79	95	111	127


MAGIC MADE EASY BY DAVID DEVANT

The Breaking-Point Puzzle

An interesting bet you can challenge your friends to is shown at the left. Tie a piece of string around the middle of a fairly heavy book, say two or three pounds. Then fasten one end of the string securely to a doorknob so that the book hangs about a foot down from it. Taking hold of the string below the book you bet anyone who is foolish enough to wager with you that you can pull the string and make it break either above or below the book at will. Your assignment, Mr. Phelps, if you care to accept it, is to figure out how this wonderful feat of ledgerdermain was accomplished.

Stung Again

We received a very nice letter the other day from a gentleman in Israel who enjoys the puzzles in this column. He has sent us an interesting "what's the next number" type of puzzle which Merlin likes very much. Our thanks go out to Mr. Dov Minz, of Ramat-Gan, Israel. A copy of "Merlin's Puzzler 1" is on the way.

Your problem is to supply the missing number in the set of numbers given below:

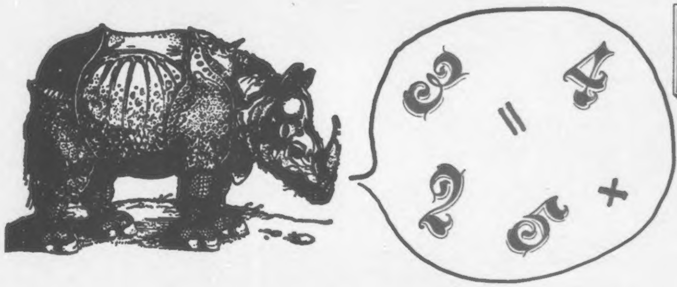
61 52 63 94 46 ?

An Addition Quickie

What is the sum of all of the numbers from 1 to 100? If you can fathom the secret to this puzzle you will be able to do it in your head in about 5 seconds.

The Rhino's Riddle

Rupert has been having a great time stumping everyone at Merlin's court with a new math puzzle. The puzzler is required to arrange the four numbers 2, 3, 4 and 5, along with a plus sign and an equal sign, into a valid mathematical equation. (From "Merlin's Puzzler 2").

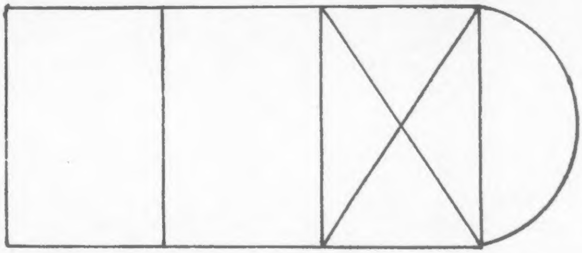


The Firm Grip Puzzle

Mr. Tarlus Paul Balog sends us a puzzle which he says is extremely hard to understand. Merlin agrees with him. We think that the answer he gives here is correct, and if it isn't I know that our readers will be quick to set us straight. This is Mr. Balog's second puzzle to appear in *Creative Computing* and we will send along a copy of "Merlin's Puzzler 1" to reward him for his efforts. The puzzle goes like this:

Five married couples go to a party. As they arrive they exchange various handshakes. After everyone arrives, one person lines all the other people against a wall. He asks each of them how many hands they shook when they arrived. They each give him a different answer. Now, consider that no one has shaken their own hand, and that they did not shake their spouse's hand. How many hands did the man who lined them against the wall shake?

A Very Old Game



If you look at the figure at the left you will see the layout of a very old children's game called, you guessed it, Hopscotch. The layout lends itself very nicely to the class of puzzles known as continuous line problems. The puzzler is required to draw the hopscotch layout using one continuous line. No part of the line can cross over any other part and you cannot go back over any section. (This puzzle is from "Merlin's Puzzler 3").

We had some interesting puzzles for you this issue. Merlin looks forward to hearing from our readers, and, he urges any of you who have a favorite puzzle to send it in and share it with the rest of us. If Merlin uses your puzzle he will send you a copy of one of his books. If you wish to buy any of the "Merlin" books, and cannot find them in your local bookstore, drop a line to *Creative Computing,* they carry the full line.

See you again next month!

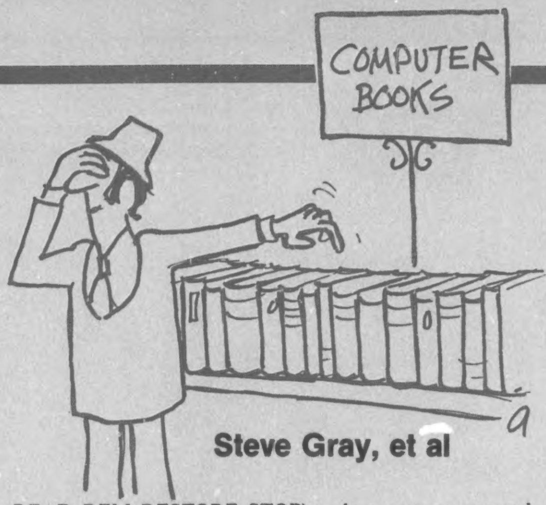
Your editor,

Charles Barry Townsend

Charles Barry Townsend

Answers on page 192.

Reviews



Steve Gray, et al

Basic BASIC: An Introduction to Programming, by Donald M. Monro. Winthrop Publishers Inc., 17 Dunster St., Cambridge, MA 02138. 103 pages, paperback $6.95. 1979.

If this title seems familiar, it's because a "Basic Basic" by James Coan was published by Hayden Book Co. in 1970. Monro's book was first published in London, where the author teaches at the Imperial College of Science and Technology.

Monro's book teaches the use of 18 Basic statements: DATA, DEFN, DIM, END, FOR/TO, GOSUB, GO TO, IF/THEN, INPUT, LET, NEXT, ON/GO TO, PRINT, READ, REM, RESTORE, RETURN, and STOP. They're covered in 14 "units" (chapters) on Getting Started, Arithmetic, Communicating, Repeating Calculations, Making Decisions, Built-in Functions, Loops, Printing and Graph Plotting, Defining Functions, Lists, Strings, Defining Values in Advance, Subroutines, and Tables.

An appendix provides a 10-page summary of basic Basic. The style is straightforward, and the writing clear and simple. The book starts with a two-line program, gives a flowchart immediately, and goes right into listing and editing it. The unit ends, as they all do, with several simple problems.

The subsequent chapters build up awhile on the first program, which is essentially PRINT 2+2. No program contains more than about a dozen lines (including several REMs), and most are half that long. The nine flowcharts are all in the first seven units.

The buildup is slow, easy and logical. Several of the problems for units 7 and 13 may be somewhat difficult for some readers who haven't gone beyond trigonometry: they involve evaluating 10 terms of the MacLaurin series for sin x, permutations and combinations, the trapezoidal rule in finding the area under a curve, Newton's method for solving equations, and Simpson's rule.

But these are minor points in a book that, although rather expensive for only 103 pages, can be recommended for a fast course in Basic.

The text is typed, very neatly and very legibly, with all the programs and program lines in larger type. Altogether a very neat and handy book. The book lives up to the back-cover blurb that claims "the level of problems and examples is neither so banal as to insult the intelligence of the reader, nor so advanced as to be bewildering."

* * *

BASIC: A Unit For Secondary Schools, by Donald D. Spencer. Camelot Publishing Co., Box 1357, Ormond Beach, FL 32074. 96 pages, paperback $3.95. Second edition, 1980.

Teacher's Manual for BASIC: A Unit for Secondary Schools, by Donald D. Spencer. 90 pages, paperback $8.95. Second edition, 1980.

This book, according to the preface, "is designed to be used as a supplementary text to courses in secondary school education." Written for students with no knowledge of computers, it "may be used in conjunction with courses in algebra, geometry, computer science, business, science, advanced mathematics, chemistry, physics, social science, or fine arts."

The first five chapters are titled Meet The Computer, Elementary Basic, Control Statements and Loops, More Basic, and Arrays. The sixth chapter is a 16-page Glossary of Computer Science Terms.

Only 14 Basic statements are covered (DATA, DIM, END, FOR, GOTO, IF-THEN, INPUT, LET, NEXT, PRINT, READ, REM, RESTORE, STOP), and two system commands (LIST, RUN).

The book uses a hands-on approach, asking the student on page 16 to enter a 7-line program that evaluates a simple algebraic expression for 7 values of X. Three more programs are presented to be entered, without being explained, to make the student "familiar with using the computer terminal."

The second chapter starts out with a three-line program and gives exercises after each group of statements, a total of five sets of exercises, 54 in all.

The subsequent chapters develop the use of Basic, with programs usually no more than 6 to 8 lines long, and all contain a large variety of well-chosen exercises.

Although the book says that "programs in this book were typed and run on Radio Shack TRS-80 and Apple II microcomputers," no graphics are discussed, so the book could be used with almost any Basic.

Spencer writes in a fairly simple style that explains the basics of Basic quite well. However, the book could benefit by the use of more white space and fewer heavy chunks of text, to make it look a little less formidable.

While the student edition is small (5½ by 8 inches), the teacher's manual is a full 8½ by 11 inches, and consists mainly of figures that "may be reproduced as overhead projection transparencies or as 35mm slides by individual teachers to use with their students who are studying the text."

The first 22 figures are for introducing computers, and show what a simple computer looks like, the five basic parts of a computer, some types of input material, etc., in combinations of words and line drawings.

The remainder of the 78 figures are programs or parts of program, many identical with those in the student edition. The rest of the teacher's manual consists of a dozen pages on how to use the figures, with chapter-by-chapter information on the chapter's purpose, teaching materials, and teaching suggestions. Also provided is a list of reference periodicals, tips on taking the class on field trips, using guest lecturers, using the chalkboard and flipcharts, and six additional Basic problems.

Secondary-school teachers of elementary Basic should check out these publications.

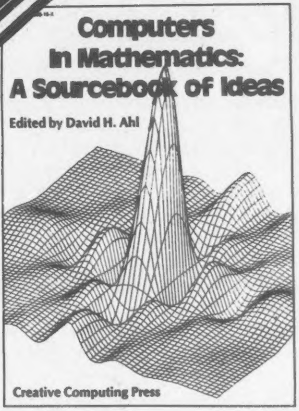
* * *

Accounts Payable & Accounts Receivable — CBasic, by Lon Poole with Mary Borchers, Martin McNiff, and Robert Thomson. Osborne/McGraw-Hill, Berkeley, CA. 366 pages, paperback $20. 1979.

General Ledger — CBasic, by Lon Poole with Mary Borchers, Martin McNiff, and Robert Thomson. Osborne/McGraw-Hill, Berkeley, CA. 186 pages, paperback $20. 1979.

These are the second and third in the Osborne/McGraw-

NEW



Computers in Mathematics: A Sourcebook of Ideas

Here is a huge sourcebook of ideas for using computers in mathematics instruction. There are sections on:

*Thinking Strategies and How to Solve Problems
*How to Buy a Microcomputer System
*Art, Graphics, and Mathematics
*Computer Assisted Instruction
*Computer Simulations
*Programming Style
*Probability
*Magic Squares and much more.

One section presents over 250 problems, puzzles and programming ideas, more than are found in most "problem collection" books.

Pragmatic, ready to use, classroom tested ideas are presented for everything from the most basic introduction to binary numbers to advanced techniques like multiple regression analysis and differential equations. Every item discussed has a complete explanation including flowcharts, programs, and sample runs.

The book includes many activities that don't require a computer. And if you're considering expanding your computer facilities you'll find a section on how to select a computer complete with an invaluable microcomputer comparison chart.

Although much of the material has appeared in Creative Computing, many of those back issues are no longer available. Consequently this book meets the demand of making available that popular information.

Edited by David Ahl. Large format paperbound, 224 pages, $15.95. (12D)

To order use handy postcard order from inside back cover.

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Tape 3, People's Pascal I	$19.95
Tape 6P PASPATCH allows old Pascal II (no longer available) to use printer, floppy disk	$15.00
Tape 1, 34 business, educational, game programs	$10.95
Tape 2, 77 programs from Osborne book: 'Some Common Basic Programs'	$10.95
Tape 5, 24 business, educational, game programs	$10.95
Tape 7, 31 business, educational, game programs	$10.95
Tape 8, about 30, including 1,700-baud tape loader	$10.95

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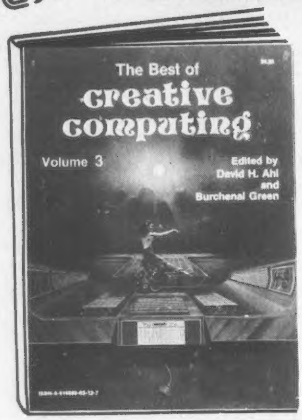

336 pages of articles, activities, fiction, games, programs, reviews, cartoons, and other information from the 1977 issues of Creative Computing. Includes features on technology, public access, educational use, medical applications, and computers in music. Contains great resource listings and reviews of calculators, games, equipment, software and books. There are 96 pages of things to do—puzzles, programs, problems, and games.

A sample of the diverse contents is listed.

Edited by David Ahl and Burchenal Green. Large format. 336 pages. $8.95 (12C).

Partial Listing of Contents -

- **Technology—Present and Future**
  - Trends Into the Future—Gray
  - EFTS: Living is Better Electronically, or IS it?—Dragunas
  - The World In Your Own Notebook—Lees
  - Eeny, Meeny, Micro and More—Salisbury
  - The Pocket Computer Is Almost Here—Ahern
  - Microprocessors—A Primer—Cohen
- **Public Access**
  - Computing at a Public Library—Shair
  - Computer Power to the People—Ahl
  - A Dream For Irving Snerd—Nelson
  - Time For a National Computer Club—Kuzmack
  - The Microcomputer Inflicts "Future Shock" on Technical Education—Vuillequiz
- **Computers In Education**
  - Interactive Computing in Secondary Schools in France-
  - A Microcomputer Software Course—Williams
  - Computer Science at Carnegie-Mellon University—Hast
  - Final Exams—Eisenberg
  - Computational Unsolvability—Steen
  - State-of-the-Art vs Compatibility—Ahl
- **Languages and Programming Theory**
  - Something Is Missing—Finseth
  - File Structures—Lees
  - PILOT—Yob
  - A Taste of APL—Finseth
  - ARTSPEAK—Friedman
- **Fiction and Foolishness**
  - The Land of Halco—Rowlett
  - Them Hobbyists—Dunion
  - Computer Control—Vitale
  - Yellow Computer—Ragen
  - Edu-Man Meets Pseudo Hero—Ahl
  - Edu-Man Meets the Rumor Mongers—Ahl
  - The Lighter Side of Robots
  - The Lighter Side of Computer Dating
  - Nords—Sunstone Graphics
  - Glorobots—Maxson
  - The Floating Point Solution—Taylor
  - Martsport—Sonntag
  - Out of the Mouths of Babes—Wirth
  - Still a Few Bugs in the System
- **Games**
  - Othello—Wright
  - SWARMS—Miller
  - EUCHRE—Raybaud
  - Daytona 500—Churchill
- **Reviews**
  - **Of Calculators**
    - Sophisticated Electronic Pocket Calculators
  - **Of Games**
    - Smart Electronic Games—Ahl
    - Comp IV—Gray

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CIRCLE 350 ON READER SERVICE CARD

Hill series of business-software books with programs written in CBasic. They are translations of earlier Osborne books of the same titles, by Poole and Borchers. Another earlier Osborne program book, Payroll With Cost Accounting, was the first to be translated into CBasic for the new series.

These two latest books are almost exactly like the previous editions, except that the programs are in CBasic version 2, "a popular commercial Basic for 8080/Z80 microcomputers which use a CP/M operating system," according to the back covers.

The new versions are spiral-wire bound, and although the wire-ends are tucked in, somehow they do tend to catch on various things.

Features of the Accounts Payable and Accounts Receivable book include accounts-payable check-printing with invoice detail, accounts-payable invoice aging; automatic postings to general ledger; accounts receivable progress billing, partial-invoice payments, customer statements and invoice aging.

The AP & AR book contains an operator's manual, with screen-display formats and sample reports, plus file descriptors and layouts, an explanation of important CBasic features, suggestions on how to change the programs, and program and data-file installation instructions.

The AP & AR program listings include 22 application programs and 14 support modules, a total of 138 pages, with many in-line REMARKs, and a cross-reference glossary.

The AP & AR programs were developed on a Wang 2200 mini. Only about one out of every 10 lines has a line number, so, as the book puts it, "If you are converting the listings to another version of Basic, you may have to assign line numbers to every statement. This will mean changing some of the existing line numbers. Be sure to also change any GOTO's or GOSUB's that reference the changed line numbers."

Features of the General Ledger book include accepting postings from external programs (Accounts Payable, Accounts Receivable); accepting directly-entered postings; maintaining account balances for current month, quarter, and year and previous three quarters; and financial reports such as Trial Balance, Income Statement, and Balance Sheet.

The General Ledger book contains an operator's manual with screen-display formats and sample reports, and the other usual features of an Osborne/McGraw-Hill book.

The General Ledger program listings include eight application programs and 8 support modules, a total of 56 pages, with in-line REMARKs, and a cross-reference glossary.

As usual with Osborne/McGraw-Hill books, these two are complete in just about every possible detail, such as the source documents being documented with in-line remarks.

All you need is $20 each and somebody with enough patience to input all 194 pages of programs into your computer via the keyboard. (Actually, you can get these programs on disk from several sources.)

* * *

Foundations of Programming Through Basic, by Peter Moulton. John Wiley & Sons, New York. 282 pages, paperback $12.95. 1979.

This textbook, meant to be used hands-on with a time-sharing system, may be the only computer book ever written that starts out "Once upon a time." Perhaps the author was trying to be a little different from all the rest of these books on computer languages. He succeeds in making the opening, and various similar portions of the book, seem rather "folksy" and "down home."

But don't let this, and some occasional excessive wordiness, put you off; Moulton has written a good book. It would be better if some of the many long paragraphs were broken up, and if some of the Teletype output were a little less authentic-looking and a little more readable. The occasional jaunts into folksy writing seem contrived, almost as though the author had felt that, every X pages, he should get a little chummy with the reader.

That aside, Moulton does quite well in building up a steady background, starting with short programs (most of them with RUNs), working up to longer ones in due time. Even the two-page programs are quite easy to figure out, what with many REMs and indents.

After the usual chapters on basics, program structure, flowcharting and files, Moulton gets into three chapters that few authors explore in such a textbook: Sorting and Searching, Numerical Methods (approximate numbers, finding roots of functions, finding areas under curves), and Modeling and Simulation (population, stochastic models and random numbers).

The textbook's faint military air (paragraphs numbered 5.3, 5.4, etc.) reaches a curious peak found in no other book on Basic: an annoying system of flowcharting without the charts. What would have been much easier to understand with the boxes and lines, is now dull and complex, with statements "refined" unto the fifth level: 1.2.2.3.1 and 1.2.2.3.2, for example. Interesting as a concept, but deadly when you have to plow through it as a student. However, this is more of a personal prejudice against military-handbook style than anything else.

The second edition of this textbook should be a real winner.

* * *

The First Book of Ohio Scientific. Vol. I, by J. Clothier and W. Adams. Elcomp Publishing, Inc., Chino, California. 188 pages, paperback, $7.95. 1980.

Reading this book is something like selecting from a large smorgasbord table while blind-folded. One may come up with a very tasty dish, but quite at random from its normal place in the menu. The title indicates that a laudable effort has been made to reveal the mysteries of OSI's computer systems to often perplexed and frustrated owners. However, what is first is not always best, and the book's organization could have benefited from a rigorous and unhurried editorial analysis along the lines of the greatest user need and interest.

The first twenty pages or so, for example, appear to have duplicated OSI sales literature, instead of examining omissions and errors in the technical documentation accompanying the hardware. Other excerpts from the company's manuals are scattered throughout the text, some of which are relevant to explanations and modifications, but others which should have been edited or omitted. Since Basic is such a fundamental aspect to the average user, it should have been "brought up" much earlier in the book.

As a new Superboard II owner, this reviewer was mystified by various unused keys like ESC and LINE FEED, the lack of a collected board pin-out listing, the many unoccupied IC sockets, and especially, the mysterious graphic symbols, some of which seemed dedicated to the composite formation of exotic video game characters. A good cursor program, utilizing some of the inoperative keys, perhaps, would have been a desirable addition to the book.

What should *not* have been included, was the authors' effrontery to the reader on pages 145 and 146. Here we find a description of what seems a desirable "High Resolution Display Conversion" for the Superboard, reproduced from an article by one Steven Chalfin. After a listing of necessary components, we turn in expectation to the next page, only to learn that; "The complete conversion is available from myself (Chalfin) at a cost of $12.00."(!) It is this sort of (hopefully unintentional) unethical publishing that has given a bad name to an entire family of "computer books".

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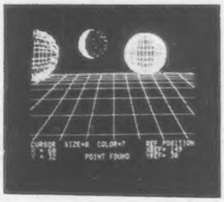

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In summary, this book has undeniably useful information to OSI computer users, but at a list price of $7.95, it is priced some $6.00 too high. Let us hope that the authors will more carefully consider the priorities and *sensibilities* of their readers in promised future volumes of *The First Book*.

— Frederick W. Chesson

* * *

Calculating With Basic, by Raymond Guido. Scelbi Publications, Box 133 PP Stn, Milford, CT 06460. 80 pages, paperback $7.95. 1979.

The front cover says this is "For mathematics, finance and statistics, mechanical engineering and electronics." The back cover says it presents a "variety of routines and programs in Basic language to assist the student, scientist, engineer, technician or hobbyist apply the language to technical problems."

The mathematics chapter includes programs to solve the quadratic formula, general summation formulas such as the sum of a geometric progression, number conversion, trig functions, transcendental functions, and graphing programs for circles and ellipses.

The financial programs include discount, interest, payback periods, mortgage schedules, and extended precision. The chapter on mechanics gets into resultant-force calculations, attractive forces due to gravity, projectile-motion prediction and graphing, and moments of inertia for T-section, I-section and channel section. The chapter on electronics includes programs involving Ohm's law, capacitor charge and discharge times, inductors and resonant frequencies, and decibels.

The last chapter, on Games, features Space Capture and Hangman, "for fun in between such serious applications."

The programs are presented with explanations and formula sum derivations, and require a knowledge of elementary Basic. Most of the 42 programs include a RUN; all are LISTed with fairly clear dot-matrix printouts. The Basic used seems to be Microsoft's.

The book seems mainly of interest to engineering students, and badly needs an index. Also, the 8½-by-11 inch size could be reduced to six inches in width, by eliminating the extra-wide margins, which are taken up here and there with lists of the Basic functions used in the adjacent programs. No reason for these marginal notes is given, or evident.

* * *

Microprocessor Software Design, edited by Max J. Schindler. Hayden Book Co., Rochelle Park, NJ. 297 pages, paperback $11.95. 1980.

The 45 articles in this book were selected from the pages of Electronic Design by that magazine's Software/Systems Editor. They are divided into nine groups, including top-down software design, hardware, operating systems, microprogramming, hardware/software tradeoffs, program development aids, high-level languages, plus two general areas.

The articles will be of most interest to software design engineers, of course, but there is enough here to be of interest to anyone who's into software. To Electronic Design's great credit, almost all the articles are written as simply as possible, so that even the neophyte can get something out of what could easily have been written in engineering gobbledygook.

A few of the articles will have a narrow audience, such as "Develop Systems Around the SC/MP" and "Cut Controller Costs with Microcoded Bit Slices," which are aimed at the professional. But such articles are in a very small minority in this useful, highly readable compilation that, if nothing else, provides the software bug with much good background.

If one must look for faults, then perhaps the editor could have indicated from which issues of ED the articles were taken, so readers could have some idea of just when they were written.

* * *

Home Computers: 2^{10} Questions & Answers Volume I: Hardware By Rich Didday, Dilithium Press, 1977. 265 pages, $8.95. Volume 2: Software 230 pages, $8.95.

There are many "elementary" books on the market. Most of them start at the beginning and end there too. There are few books on the market for non-beginners. For the most part they are readable only by those who don't need to read them. There are a growing number of books that attempt to start at the beginning and make progress toward a state of knowledge that might be considered intermediate. Home Computers is certainly one of the more successful attempts along these lines. The only fault this reviewer found with the book was that it wasn't long enough. Perhaps a sequel will be written some day.

The book is stated to be a "heavily edited transcription of nine days of conversation." For this reason, presumably, it is divided into Days instead of Chapters. Day 1 is an overview covering such things as the organization of computer systems, what I/O devices do, buzz words, the various levels of programming language, the kinds of busses, buffers, counters, registers, flow charts, etc. all in very simple yet definitely non-trivial terms.

Day 2 covers number systems, complement arithmetic, Boolean algebra, circuit components and truth tables, flip-flops, timing, printouts, drivers, etc.

Day 3 covers all kinds of diagrams: functional block diagrams, pin configuration diagrams, circuit diagrams, system configuration diagrams and timing diagrams. Day 3 contains a lot of information that this reviewer has never seen anywhere else, and for the serious beginner, this section alone is worth the price of the book.

Day 4 asks "What's it like to assemble a microcomputer kit?"

Day 5 covers specific microprocessors. It starts with 8080, 6800, and Z-80 architecture and gets into the instruction sets and addressing briefly.

This book was thoroughly enjoyable to read, and one of the most enjoyable aspects was the way the questioner shook the guru. He did what many a reader has undoubtedly wanted to do to an author when the point was not pursued far enough or when the explanation fell short of the mark. In this case the questioner kept banging away with "why", followed by "why", in the same manner in which small children drive parents crazy. It was very satisfying to read on and finally get the whole story. The book is very highly recommended.

Volume 2 also starts at the beginning, but since it treats a relatively broader area of programming there isn't time to progress much beyond the beginner level. Perhaps if the reviewer's level of knowledge in the hardware and software areas were reversed so might his evaluation of the two books.

Volume 2 starts at the beginning of Day 5, somewhat before the end of Volume 1, thereby easing the transition from hardware to software. Day 5 discusses specific microprocessors, primarily the 8080, Z-80, and 6800.

Day 6 asks, "What's it really like to program in machine and assembly language?"

Day 7 was apparently the day of rest, since there is no Day 7 either in the text, nor in the Table of Contents. This is too neat to have been an error.

Day 8 asks, "What's it like to program in Basic?" After a brief discussion of the advantages and disadvantages of Basic versus assembly language (in which the author concludes that assembly language comes out second best, over all), the remainder of the chapter is devoted to writing a drag race game in Basic. It is quite well done and certainly very educational as far as it goes.

Day 9 covers "Generalities about programming", and is a medley of miscellany not covered elsewhere.

Day 10 gets involved in what you can do, and what you can't do with the computer.

This book is very readable and will take the beginner a long way toward understanding what software is all about and what is meant by the word "programming." As in Volume 1, but to a lesser extent, it was enjoyable to watch the questioner continue to shake the guru until the latter came across with a satisfactory answer. For those who are thinking about learning assembly language or Basic and want to see what they are getting into, or for those who just want to know what all the noise is about, this book is highly recommended. — Alfred Adler, Ph.D.

* * *

All About Personal Computers, Datapro Research Corporation, Delran, NJ 08075. 68 pages $25.00. 1980.

This report might be useful to a very limited number of people. It is not a guide for the beginner since it throws around technical terms with the fluency of a third-year engineering student, and it won't help old pros since they usually have ten times as much information stored in boxes in the attic, but for those in the middle, those who understand the jargon but don't know the specifics of various home computers, this book might be useful. After a brief history of personal computers and a discussion of their uses, manners of sale, and advice for buying one, we get to the core of the book. Here, in detail, are all the facts about 15 popular computers. From Apple to Texas Instruments, the book gives a wealth of information; prices, type of keyboard and display, available peripherals, and so on. But this is the sort of information that most manufacturers love to provide for free. And, usually, they provide the information in greater detail and with greater accuracy. Tiny omissions and mistakes popped up throughout the book: they mention the paddles as part of the Apple's I/O, but don't mention the full capability of the paddle plug; they list a number of software vendors, but give no indication of which computers are supported by these vendors; peripheral vendors are also listed without mention of the systems they support.

If you need all this information, and don't have time to write to the companies, then this book might be useful. But it contains nothing that can't be found elsewhere. — *D.L.*

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Puzzle Answers

It's In The Cards: The seven cards are drawn upon a mathematical principle, in such manner that the *first numbers of those in which a given number appears,* when added together, indicate that number.

Suppose, for instance, that the chosen number is 63. This appears in cards I, II, III, IV, V and VI. The key numbers of these are 1, 2, 4, 8, 16 and 32; and 1 + 2 + 4 + 8 + 16 + 32 = 63.

If the number 7 is selected, this appears only in cards I, II and III, whose key numbers are 1, 2 and 4 = 7.

The principle of construction seems at first sight rather mysterious, but it is simple enough when explained. The reader will note, in the first place, that the first or "key" numbers of each card form a geometrical progression, being 1, 2, 4, 8, 16, 32, 64. The total of these is 127, which is accordingly the highers number included.

It is further to be noted that by appropriate combinations of the above figures *any* total, from 1 to 127, can be produced.

The first card consists of the alternate numbers from 1 to 127 inclusive. The second, commencing with 2 (the second term of the geometrical series), consists of alternate groups of *two* consecutive figures — 2, 3; 6, 7; 10, 11, and so on. The third, beginning with 4, the third term of the series, consists of alternate groups of *four* figures — 4, 5, 6, 7; 12, 13, 14, 15; 20, 21, 22, 23; and so on. The fourth, commencing with 8, consists in like manner of alternate groups of *eight* figures. The fifth, commencing with 16, of alternate groups of *sixteen* figures. The sixth, commencing with 32, of alternate groups of *thirty-two* figures; and the last, commencing with 64, of a single group, being those from 64 to 127 inclusive.

It will be found that any given number of cards arranged on this principle will produce the desired results, limited by the extent of the geometrical series constituting the first numbers.

The Breaking Point Puzzle: To break the string below the book give the string a sharp downward jerk. You will be pulling against the inertia of the two pound book and the string should break before any of this force is transmitted to the string above the book. To break the string above the book pull slowly on the string. The force you exert, plus the weight of the book, will cause the string above the book to snap first.

Stung Again: Turn each number around and you will get:

16 25 36 49 64 or 4^2 5^2 6^2 7^2.

The missing number therefore is 18.

($9^2 = 81$ turned around)

An Addition Quickie: If you were to pair the first 50 numbers with the last 50 numbers in the following manner:

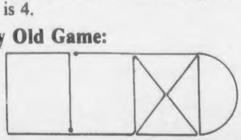
1 and 100 = 101, 2 and 99 = 101, etc.,

you would end up with 50 pairs each of which had a value of 101. If you multiply 101 by 50 you get 5050 which is the answer we are looking for.

The Rhino's Riddle: $3^2 = 4 + 5$.

The Firm Grip Puzzle: The answer is four. It works out this way. The number of hands that were shaken by the people against the wall were 0 thru 8 (each different). Since (8) shook everyone's hand except his own and his spouse's, his spouse must not have shaken any (0). (7) shook everyone's hand except his own hand, (0)'s hand, and his wife's. Since there must be a (1) his wife is (1). (6) shook everyone's hand except (0), (1), his own hand, and his wife's. (2), therefore, shook the hands of (7) and (8) and is married to (6). It follows in suit that (5) is married to (3), and (4) is married to the man who lined the people up in the first place! So the answer is 4.

A Very Old Game:



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180	185	190	195	200	330	335	340	345	350
201	206	211	216	221	351	356	361	366	371
202	207	212	217	222	352	357	362	367	372
203	208	213	218	223	353	358	363	368	373
204	209	214	219	224	354	359	364	369	374
205	210	215	220	225	355	360	365	370	375
226	231	236	241	246	376	381	386	391	396
227	232	237	242	247	377	382	387	392	397
228	233	238	243	248	378	383	388	393	398
229	234	239	244	249	379	384	389	394	399
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104	109	114	119	124	254	259	264	269	274
105	110	115	120	125	255	260	265	270	275
126	131	136	141	146	276	281	286	291	296
127	132	137	142	147	277	282	287	292	297
128	133	138	143	148	278	283	288	293	298
129	134	139	144	149	279	284	289	294	299
130	135	140	145	150	280	285	290	295	300
151	156	161	166	171	301	306	311	316	321
152	157	162	167	172	302	307	312	317	322
153	158	163	168	173	303	308	313	318	323
154	159	164	169	174	304	309	314	319	324
155	160	165	170	175	305	310	315	320	325
176	181	186	191	196	326	331	336	341	346
177	182	187	192	197	327	332	337	342	347
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179	184	189	194	199	329	334	339	344	349
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